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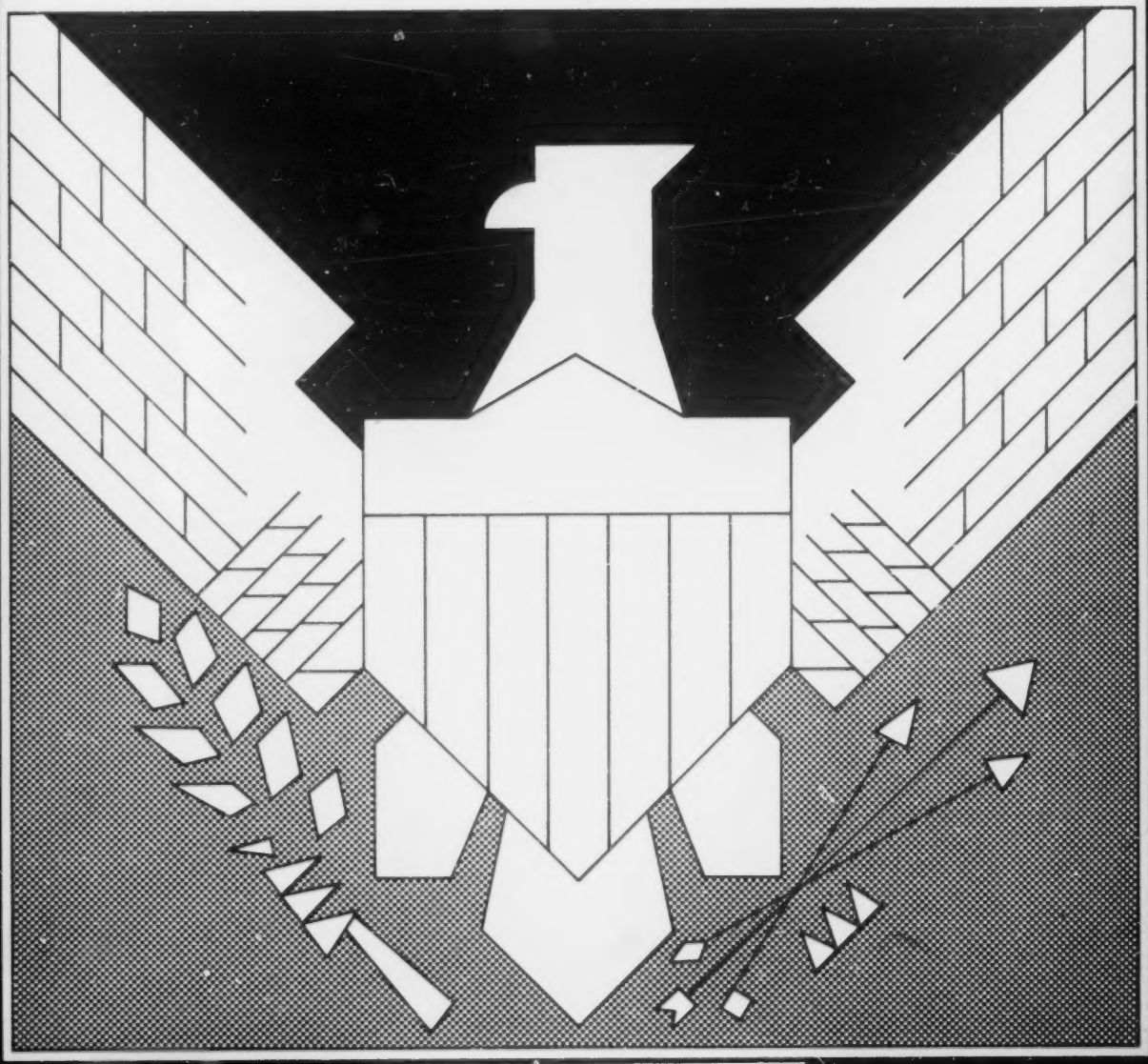
Modernizing U.S. Strategic Offensive Forces: Costs, Effects, and Alternatives



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MODERNIZING U.S. STRATEGIC OFFENSIVE FORCES: COSTS, EFFECTS, AND ALTERNATIVES

The Congress of the United States
Congressional Budget Office

NOTES

Unless otherwise indicated, all years referred to in this report are fiscal years.

Unless otherwise indicated, all dollar amounts are expressed in constant fiscal year 1988 budget authority dollars.

Life-cycle costs exclude funds that have already been appropriated.

Details in the text, tables, and figures of this report may not add to totals because of rounding.

PREFACE

The Administration announced its plan to modernize all parts of the United States strategic deterrent in October 1981. Since then it has substantially completed one wave of procurement of strategic offensive forces, encompassing all legs of the triad: land-based and sea-based intercontinental ballistic missiles plus long-range bombers. Plans for a second wave of procurement are under way and may well cost more than the first. The Administration's budget requests show that spending for strategic forces will grow more rapidly than that for the total defense budget.

By many commonly used measures, the Administration's program has added significantly to the capability of U.S. strategic forces and will continue to do so. However, not everyone agrees with the priorities and goals of the Administration's program. The constrained budget outlook is likely to sharpen debate about the relative share of the nation's future resources devoted to defense and about allocations within the defense budget for strategic forces. Reductions in the defense budget over the past two years have been accommodated without any fundamental change in planned strategic programs. If the budget trend continues, however, Congress may be faced with more difficult choices, possibly affecting the structure of U.S. strategic forces for many years.

This study analyzes the effects of the Administration's plan for modernizing the strategic offensive forces and discusses alternatives that would reduce costs. The study was requested by the House Committee on Armed Services. In keeping with the Congressional Budget Office's mandate to provide objective analysis, the study contains no recommendations.

Bonita J. Dombey of CBO's National Security Division prepared the study under the general supervision of Robert F. Hale and John D. Mayer, Jr. William P. Myers of CBO's Budget Analysis Division provided detailed cost analysis. The author sincerely appreciates the contributions of James West, Jeffrey Merkley, and Dan Kaplan of CBO, and many others who made useful suggestions at various stages of the study. Paul Houts and Sherry Snyder edited the manuscript. Nancy H. Brooks, Rebecca Kees, and Kathryn Quattrone prepared the report for publication.

Edward M. Gramlich
Acting Director

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SUMMARY

United States strategic forces are primarily intended to deter the Soviet Union from initiating a nuclear war. To do so, U.S. policy calls for them to be able to survive a Soviet nuclear strike and retaliate in an appropriate and timely manner. Since the 1960s, the Soviets have upgraded and significantly expanded the capabilities of their strategic forces. The Administration believes that in response the United States must increase not only the numbers of its forces and their chance of surviving a Soviet strike, but also their destructive capability, endurance, and responsiveness.

Indeed, modernizing and upgrading the strategic forces and their associated command and control has been one of the highest priorities of the Administration's defense program. The Administration has already substantially completed one wave of strategic procurement, including the first 50 MX missiles to be placed in existing silos, B-1B bombers, and the majority of new Trident submarines. When fully fielded, these systems will increase available strategic warheads by roughly 25 percent above 1981 funded warhead levels. The Administration plans a second wave of procurement that may well cost more than the first. The broad scope of the program, coupled with its substantial cost and limits on Congressional willingness to increase total defense spending, is likely to generate sharp debate.

THE ADMINISTRATION'S MODERNIZATION PLAN

The Administration's modernization plan would continue procurement of several major weapons systems through the mid-to-late 1990s. While not all the details of the plan are available publicly and, in some cases, ultimate force levels have not been determined, this study assumes the modernization plan includes:

- Deployment beginning in the early 1990s of 500 new, single-warhead, small intercontinental ballistic missiles (SICBMs) in a mobile basing mode;

- Deployment by the mid-1990s of 50 MX missiles on railroad cars;

- Procurement in the early-to-mid 1990s of 132 Advanced Technology Bombers ("stealth bombers") designed to penetrate the Soviet Union;

- Procurement by the early 1990s of about 3,200 air-launched cruise missiles (ALCMs) with about 1,500 of those being Advanced Cruise Missiles (ACMs) that reportedly have greater range than earlier versions and are harder to detect with air defense radars (cruise missiles are essentially small, unmanned aircraft that are carried near Soviet airspace by manned aircraft, initially by B-52 bombers and later by both B-52 and B-1B bombers);

- Procurement through the mid-1990s of about 1,600 new nuclear short-range attack missiles (SRAM II) to replace the current aging missiles carried on penetrating bombers;

- Continued procurement through 1993 of Trident submarines at the current rate of one per year to a total of 20, and deployment by 1996 on most Trident submarines of the new, larger, and more accurate Trident II (D-5) missile.

GOALS OF CONTINUED MODERNIZATION

Three key goals seem to characterize the Administration's plan for continued modernization, and provide a useful framework for evaluating the effects of planned programs and alternatives to them. The goals did not originate with this Administration, but it has clearly put the greatest emphasis on them and invested most in them of any recent Administration. Different views exist, however, as to what should be the proper emphasis for the U.S.'s deterrent force posture.

Supporting a Survivable Triad

This goal addresses a long-standing and key feature of the U.S. strategic force posture. A triad of strategic systems (land-based missiles,

submarine-based missiles, and bombers), a portion of each able to survive a Soviet attack, ensures that U.S. forces will be able to retaliate. Facing three types of forces, the Soviets cannot concentrate their attack, or their research dollars, on destroying any one. Also, one type of system would sometimes help the others survive an attack.

Improving U.S. Capability to Respond Flexibly to a Soviet Attack

This goal reflects the belief that the Soviets most value their tools of control and power--their military forces and leadership facilities--most of which are hardened against nuclear effects. Effective deterrence, according to this belief, requires the ability to survive a possibly extended conflict, and to retaliate against these selected targets in a flexible and timely manner. This ability, in turn, requires increasing the survivability of U.S. command and control facilities and communications links. It also requires increasing the number of survivable "hard-target" warheads--that is, warheads able to destroy Soviet military targets hardened against a nuclear attack--particularly hard-target warheads that can reach their targets promptly (meaning within minutes rather than hours).

Maintaining a Manned Penetrating Bomber

Bombers on alert already have a high probability of surviving an initial Soviet attack on U.S. bomber bases. To penetrate Soviet airspace on a retaliatory mission, however, manned bombers must traverse an increasingly formidable array of Soviet radar systems, missiles, and airborne interceptors. Large numbers of small, air-launched cruise missiles, launched from bombers outside of Soviet airspace, can provide a great deal of flexibility and hard-target capability for the retaliatory mission and are very difficult to defend against. Nonetheless, the Administration believes that manned bombers with short-range weapons must continue to penetrate the Soviet Union to carry out missions such as locating and destroying mobile strategic systems.

EFFECTS OF MODERNIZATION ON COSTS AND GOALS

The projected balance of forces suggests that the planned U.S. buildup could move toward accomplishing these key goals despite continuing Soviet modernization and expansion of their forces. The U.S. buildup will also add substantially to costs.

Projected Balance of Forces and Administration Goals

Under the Administration's plans, the United States would maintain a survivable triad of strategic forces, one of its key goals. The leg of the triad most threatened by a Soviet attack today--land-based missiles--would be much more likely to survive because of the deployment of MX missiles and the small ICBM in mobile basing modes. The plan would also include a new manned bomber--the Advanced Technology Bomber (ATB)--thought likely to be highly successful in its ability to penetrate Soviet air defenses despite their expected improvements. Thus, another key goal would be met.

In addition, the United States would markedly increase its capability to attack hardened Soviet targets such as ICBM silos and leadership bunkers. The numbers of U.S. hard-target warheads would grow from about 4,000 today to about 9,600 by 1996 and would peak at about 11,600 when all Trident submarines are deployed. Since U.S. deterrence policy is primarily defensive, results after a Soviet attack are also important. Consider, for example, the more likely scenario of a nuclear attack preceded by friction or conventional hostility. If the United States today absorbed a Soviet attack before retaliating, it would have about 2,900 hard-target warheads, of which about 250 would be on ballistic missiles able to retaliate promptly. By 1996, however, the United States would have about 7,600 surviving hard-target warheads, of which about 3,000 would be on ballistic missiles.

Under the Administration's plans, the United States would move toward accomplishing its three key goals, although today's rough balance of pre-attack warheads could shift in favor of the Soviet Union. Today, both sides have between 10,000 and 11,000 strategic nuclear warheads. By 1996, absent arms control reductions, and assuming a moderate pace for Soviet modernization, the United States would have

about 13,000 warheads, while the Soviets could have over 17,000 warheads. Unlike the United States, much of both the current Soviet land-based and sea-based forces still have single-warhead missiles, but their newer missiles generally carry many warheads apiece.

Costs of the Plan

Meeting Administration goals will be expensive. Based on estimates from the Department of Defense (DoD) and its definition of what constitutes strategic costs--including strategic defense costs--the Administration's plan calls for spending $39.2 billion on strategic forces in 1988, and $42.1 billion in 1989. The investment portion of this total--defined as spending for research, procurement, and construction--would grow from $29.1 billion in 1988 to $31.8 billion in 1989 (see Summary Table 1). This increase represents real growth in total strategic costs of 10.1 percent in 1988 and 7.4 percent in 1989. That growth would increase the share of the DoD budget spent on strategic forces from 11.9 percent in 1987 to 13.4 percent in 1989, raising concerns that the United States is spending an increasing share of its defense budget on strategic forces, perhaps at the expense of nonnuclear or conventional forces.

The share of the defense budget for strategic forces could continue to rise beyond 1989. Several major offensive force modernization programs--such as the SICBM and ATB--will be moving from the relatively less expensive stage of research into procurement during this period. Though not the focus of this study, costs for the Strategic Defense Initiative are also expected to increase greatly. Beyond 1989, however, DoD estimates of strategic costs are not publicly available.

Effects of Recent Arms Control Proposals

Potential limits on strategic offensive weapons--at least those agreed to in principle at the Reykjavik Summit in October 1986--need not substantially affect the Administration's modernization plan or its cost. Even so, these limits could lead to mutual reductions in strategic forces and as a result yield important benefits, including reductions in long-run costs such as having to replace fewer forces.

The limits agreed to in principle at Reykjavik--generally characterized as 50 percent reductions in strategic force levels--call for reductions over a five-year period to a ceiling of 6,000 warheads on 1,600 strategic nuclear delivery vehicles. Many areas of disagreement remain, a principal one being the U.S. Strategic Defense Initiative. These areas of disagreement prevented the United States and the Soviet Union from reaching any decisive agreement at Reykjavik, but the framework of overall limits on offensive forces will likely be the basis for any future accord. With the exception of reducing deployment of air-launched cruise missiles well below planned levels, and assuming limits on the number of warheads tested on the Trident II missile, the Administration's modernization program could be completed within these overall ceilings. Older systems, however, would have to be retired sooner than under current plans. Operating

SUMMARY TABLE 1. BUDGET FOR STRATEGIC FORCES
(In billions of 1988 dollars)

	1987	1988	1989
DoD Total Obligational Authority (TOA) a/	298.1	304.1	313.1
Strategic forces	35.6	39.2	42.1
(Investment) b/	(24.9)	(29.1)	(31.8)
Real growth (in percents)	n.a.	10.1	7.4
Strategic share of TOA (in percents)	11.9	12.9	13.4

SOURCE: Congressional Budget Office based on Department of Defense data.

NOTES: n.a. = not applicable.

Amounts are taken from Department of Defense, *Five-Year Defense Plan*. Includes supplemental appropriation in 1987. The budget for strategic forces includes funds for both offensive strategic forces and defensive strategic forces.

a. Total obligational authority (TOA) is a DoD financial term that measures the value of the direct defense program for a fiscal year. Net offsetting and trust fund receipts are not deducted from TOA as they are from budget authority (BA). They are collections from the public that arise out of the business-type or market-oriented activities of the government and are deposited in receipt accounts. In recent times, the differences between TOA and BA have been small.

b. Investment includes Procurement; Research, Development, Test and Evaluation; and Military Construction.

costs would decrease as older systems were retired, and savings could eventually average $2 billion a year. One-time costs to dismantle older systems would offset near-term savings. Cost savings could be greater if the United States chose to curtail modernization rather than accelerate retirement of existing systems. Regardless of the United States' approach, however, long-run cost savings could be substantial if fewer systems have to be replaced.

Of more far-reaching impact are the more comprehensive proposals by the United States, such as eliminating all ballistic missiles or more specific proposals such as forbidding mobile land-based missiles. The United States has reached, however, no general agreement with the Soviets on such limits. A comprehensive analysis of the pros and cons of potential arms limits is not the focus of this analysis.

ALTERNATIVES TO THE ADMINISTRATION'S PLAN

Without far-reaching arms agreements, the Administration's strategic plans could lead to widespread increases in strategic force capabilities and large real cost growth at a time when the Congressional budget resolution anticipates real declines in total defense spending. Thus, this study considers four alternatives to the Administration's plan. All of the options assume the triad would be continued. Some analysts have advocated fundamental changes in this posture, such as relying solely on the sea-based forces. Since such changes would retain only a portion of the current forces, they would certainly be less expensive. However, the overwhelming majority of policymakers have consistently decided that the protection afforded by a triad of forces is important for deterrence.

Alternative I: Do Not Backfit Trident Submarines

The first eight Trident submarines procured in the 1970s were equipped with the Trident I missiles, but the Administration plans to replace that missile with the new, larger, and more accurate Trident II missile under a backfit program. This alternative would eliminate the modification and backfit of the eight Trident submarines. Only the last 12 of the 20 Trident submarines would be deployed with Trident II

missiles, reducing Trident II procurement from 844 missiles to 660. The first backfit is not planned until 1991, but the Congress could indicate its intent to pursue this option by deleting funds in the 1988 budget for advance planning and procurement.

Effects on the Administration's Modernization Goals. The goal of increasing U.S. prompt hard-target retaliatory capability could be adversely affected by this option, though much capability would remain. The actual effect would depend on the mix of Mark 5 and Mark 4 warheads the Navy plans to have on the Trident II missiles. Only if the planned ratio of Mark 5 to Mark 4 warheads were greater than 60 to 40 would there be any reduction of hard-target warheads at all under this option. The greatest reduction in warheads would occur if all Trident II missiles were planned to carry the Mark 5 warhead. In this case, after a Soviet attack in the year 2000 (with strategic warning), the United States would have about 1,500 fewer prompt hard-target warheads under this option than under the Administration's plan, a reduction of about 12 percent (see Summary Table 2). The United States, however, would still have about 3,000 warheads able to survive a Soviet attack and retaliate promptly, compared with virtually none today. About 5,000 hard-target warheads on bombers would also be available to retaliate, though not promptly.

Some analysts argue that this substantial level of hard-target capability, though reduced below Administration plans, would deter a Soviet attack on military targets. If so, reducing "excess" hard-target warheads--which the Soviets may view as weapons intended to be used by the United States in a first-strike of its own--could increase crisis stability.

Savings. Savings would be relatively modest under this alternative. About $5.8 billion in investment costs would eventually be saved (see Summary Table 2). Investment savings would amount to only $0.8 billion over the next five years and only about $0.2 billion in 1988 and 1989, the two years of the current budget. Some increases in operating costs could make near-term savings more modest.

SUMMARY TABLE 2. COSTS AND EFFECTS OF ADMINISTRATION'S STRATEGIC PLAN AND ALTERNATIVE APPROACHES

	Investment Costs (In billions of 1988 budget authority dollars)				Hard-Target Warheads in Year 2000 a/
	Budget Costs		1988-1992	Total	
	1988	1989			
Administration's Plan	29.1	31.8	n.a.	n.a.	12,530
Savings/Changes Under:					
Alternative I: Do Not Backfit Trident Submarines	b/	0.2	0.8	5.8	-1,536 c/
Alternative II: Limit Further Land-Based Modernization					
No SICBM d/	2.2	2.3	18.0	37.4	-500
No Rail MX e/	0.6	1.2	8.4	8.4	-500
Alternative III: Cancel Manned Penetrating Bomber	n.a.	n.a.	n.a.	Over 40	+495
Alternative IV: Delay Further Modernization (Including ATB, SICBM, Rail MX, SRAM II) f/	1.7	2.4	17.9	n.a.	-424

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: n.a. = not available.

a. These numbers represent inventory counts of ballistic missiles plus bomber weapons.

b. Less than $20 million.

c. This number represents the upper bound of possible reductions in hard-target warheads under this option since it is compared with a baseline in which all Trident II missiles carry the Mark 5 warhead.

d. The SICBM Selected Acquisition Report (SAR) does not include $1.6 billion (in current dollars) of projected savings in research and development costs. The Air Force has also identified significant production cost savings. These savings are currently being coordinated with the Office of the Secretary of Defense.

e. The MX Rail Garrison SAR excludes cost of production missiles, operational test and evaluation missiles, and initial spares for the Rail Garrison Basing Mode.

f. Savings from delaying the ATB are not available and are therefore not included.

Alternative II: Limit Further Land-Based Modernization

Today's silo-based ICBM force is widely considered vulnerable to a Soviet attack. Administration plans for shoring up the land-based leg of the triad include deploying about 500 single-warhead small missiles (SICBMs) in mobile launchers hardened to some degree to withstand nuclear effects, and deploying another 50 of the 10-warhead MX missiles on rail cars. In peacetime, both systems would be situated on military bases in basically fixed sites. This arrangement holds down costs and increases security but also makes the missiles vulnerable to Soviet attack. SICBM is designed to disperse sufficiently for high levels of survivability within the 30 or so minutes of notice that a Soviet attack was actually under way. On the other hand, Rail MX would require about six hours of advance--or strategic--warning to disperse sufficiently to achieve that same initial level of survivability. (Warning from U.S. space-based and ground-based sensors that a Soviet attack was actually under way is known as tactical warning. Strategic warning, on the other hand, can consist of any number of intelligence indicators that the likelihood of an attack is increased--such as communications intelligence indicating much increased activity in some Soviet forces.) The high cost of building two new mobile systems--about $57 billion to build and operate the two systems for 15 years--has led the Congress to consider choosing one or the other of the programs.

Effects on the Administration's Modernization Goals. Choosing one of the two systems could still contribute toward the goal of a triad with independently survivable legs, but it would offer fewer warheads than planned by the Administration. Nevertheless, choosing only one system would still provide prompt hard-target retaliatory capability in the land as well as the sea-based legs of the triad, providing a hedge against technical difficulties with the sea-based force.

The degree of reduction in warheads depends on assumptions about the survivability of the systems. If they were expected to be dispersed early in a crisis, the Soviets would be unlikely to attack because doing so would use too many of their warheads. Under these assumptions, either program would provide about 500 warheads, half of the Administration's plan. (About 90 percent would be available for retaliation, since 10 percent is assumed to support a maintenance pipeline.) All of these warheads would be capable of prompt hard-

target retaliation. If dispersed only once a Soviet attack was under way, then MX would provide only a few surviving warheads. SICBM's additional speed, hardness, and ability to disperse randomly could still allow it to provide a substantial number of surviving warheads even under this assumption.

Savings. Savings under this option would depend on the choice between systems. Canceling SICBM and keeping Rail MX would save the most--about $18 billion over the next five years and an eventual total of $37.4 billion. Savings in 1988 would total $2.2 billion. Canceling MX, and keeping SICBM, would save only a total of $8.4 billion, with almost all the savings coming in the next five years. Savings in 1988 would total $0.6 billion. Operating costs would also decline. Again, canceling SICBM saves the most in operation and support ($580 million a year after full operations would have been achieved), with less savings if the MX is canceled ($240 million a year).

Which System to Cancel. As these costs imply, Rail MX is clearly much cheaper than SICBM. SICBM, however, would be more cost-effective--in terms of surviving warheads--in the event of a surprise attack where the systems were dispersed only on tactical warning.

How important is the capability to survive with only tactical warning? The United States invests heavily in operations and support of its bomber and submarine forces to assure some independence from strategic warning in each of these triad legs. While a "bolt-out-of-the-blue" Soviet attack is considered highly unlikely, history has many examples where strategic warning indicators were not acted upon, with the end result being similar to a surprise attack. Drawing conclusions about the appropriate warning sensitivity for the ICBM force from this picture is difficult. On the one hand, achieving some level of independence from strategic warning is obviously considered important and worth substantial cost. SICBM offers this independence. On the other hand, two legs of the triad have already reached this level of independence, and the requirement for the ICBM force to also have this ability may be limited.

Rail MX would be highly survivable once dispersed. However, dispersal of MX on strategic warning requires dispersal onto the public rail network, which could cause problems. Air Force officials do not consider it likely that such dispersal will interfere with the opera-

tions of the rail lines, since the number of trains carrying the MX will be such a small fraction of the total activity on the rail, and since they will only be moving periodically. However, depending on the situation, the decision to disperse might be difficult--for instance, if an Administration did not want to alarm or involve the public at a particular time.

SICBM also fulfills an Air Force requirement for single-warhead ICBMs, which is currently filled only by older Minuteman II missiles in vulnerable silos. Moreover, SICBM's launcher vehicle, which is hardened against nuclear effects and able to travel off-road, makes it more likely to survive during an extended conflict.

In summary, although the SICBM can provide advantages over the MX, they come at a significant cost. That is why choosing between the two systems would not be easy.

Alternative III: Cancel Manned Penetrating Bomber

The Congress may decide that it does not wish to limit modernization of the most vulnerable leg of the triad but must still hold down costs. If so, it could maintain a triad that could survive a Soviet attack, while forgoing the advantages of a manned penetrating bomber that is better able to penetrate future Soviet air defenses. Specifically, under this option, it would cancel procurement of the Advanced Technology Bomber (ATB) which is designed to be nearly invisible to Soviet radars. This alternative would continue to rely instead on the B-52s carrying cruise missiles and the B-1B bombers carrying both cruise missiles and short-range weapons. Because it would keep the B-52Gs longer than planned, this option would require additional procurement of about 1,200 advanced cruise missiles to fully arm the force plus modifications to keep old B-52 bombers operating at reasonable efficiency.

Effects on the Administration's Modernization Goals. This option would preserve a triad of survivable forces. With the B-1B, it would also preserve some ability to penetrate the Soviet Union with a manned bomber, although this ability would be much more limited than under the Administration's plans. Thus, the United States would be less able to detect and destroy mobile targets, such as mobile

missiles and mobile command and control systems, the number of which is expected to increase significantly. Proponents of manned penetrating bombers believe they are needed to ensure that a significant portion of these Soviet targets are put at risk in the event of Soviet aggression.

On the other hand, mobile systems are generally thought to enhance stability and deterrence, since they can survive an attack and assure retaliatory capability. Thus, opponents of the bomber believe that one of its major missions contradicts U.S. efforts to encourage both sides to deploy more survivable weapons systems. Moreover, it is hard to know how effective a manned bomber would be in search-and-destroy efforts occurring after a nuclear attack. If it is thought likely to work, the bomber could increase pressure for another round of the arms race as the Soviets try to protect their mobile systems or develop systems to attack U.S. mobile weapons. Finally, other missions for a manned bomber, such as damage assessment, could possibly be accomplished by alternate means--satellites or high-flying reconnaissance aircraft, for example, although their ability to operate in a nuclear environment is questionable.

Savings. Though savings are likely to be large under this option, they cannot be accurately assessed. The ATB is a highly classified program; only the most aggregate data about costs and effects are publicly available. Nonetheless, based on press reports of DoD statements, the total ATB program will cost $57 billion, most of which probably remains to be spent. Although there would be other changes in costs under this option, including some increases to buy more cruise missiles and to keep B-52G bombers operating, total savings could well exceed $40 billion.

Alternative IV: Delay Further Modernization

If it does not wish to terminate any programs, the Congress could still reduce the cost of strategic forces by delaying procurements. This option, for example, would delay four major programs--the ATB, SICBM, Rail MX, and SRAM II--by three years, maintaining funding for research at 1987 levels to preserve the option of later procurement. Senator Sam Nunn, Chairman of the Senate Committee on Armed

Services has recommended this general approach of delaying new systems, though not the specifics of this option.

Effects on the Administration's Modernization Goals. This option would delay modernization of the triad. The major systems affected would probably not begin to be deployed until the mid-1990s; under current plans, they would be largely deployed by this time. Warhead counts in Summary Table 2 reflect a modest decrease as a result of this delay. Beyond the year 2000, the effects of this option would rapidly disappear as the delayed systems were fully deployed.

Savings. This option would reduce investment costs by $17.9 billion over the next five years, with savings of $1.7 billion in 1988 and $2.4 billion in 1989. The amounts do not include savings from the ATB, which should add substantially to these totals. The option's effects on long-run costs are uncertain but could be higher. Keeping development teams together for longer would probably increase costs. On the other hand, some costly problems with recent systems (like the B-1B) have been attributed to overlapping development and production, which this alternative would reduce. Long-run operating costs should not change much.

CHAPTER I

INTRODUCTION

While the triad of strategic forces has been continually upgraded with new and more capable components since it was established in the 1960s, no new aircraft or land-based missiles have been procured for over 15 years. One of the highest priorities of the Reagan Administration's defense program has been to modernize and upgrade strategic forces and their associated command and control elements. This modernization has included procuring major weapons systems in each leg of the nuclear triad: land-based missiles, submarine-based missiles, and bombers.

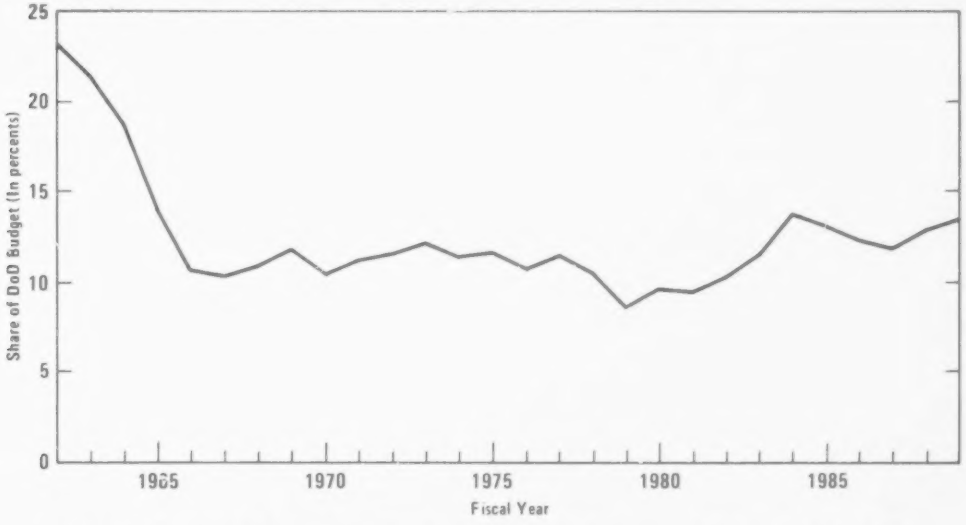
Recent budgets reflect the priority accorded strategic forces. Between 1980 and 1985, while the overall defense budget increased by an average of 9 percent a year, funds allocated for strategic forces grew by 15 percent annually. The strategic forces budget declined 7 percent in 1986 and less than 1 percent in 1987. But these two years represented an interim period between the end of major procurement for the B-1B bomber program and the beginning of major procurement for later systems like the Advanced Technology Bomber (ATB). On average, during the 1980-1987 period, the United States spent about $32 billion a year on strategic forces.

This growth affected the share of total spending devoted to strategic forces. That share rose from 9.7 percent in 1980 to 13.1 percent in 1985, and then declined to 11.9 percent in 1987. These levels differ little from the historical average: from the mid-to-late 1960s through the mid-to-late 1970s, the share of the budget for strategic forces ranged between 10 percent and 12 percent (see Figure 1). During the early-to-mid 1960s, when the United States substantially expanded its strategic forces, and also maintained very large air defense forces, the share of the budget was about 15 percent to 20 percent, and even exceeded 20 percent early in that period. (No data are available for the years before 1962.) The historical low for the strategic forces' share of the budget--8.7 percent--occurred in 1979.

Information from the Department of Defense (DoD) for 1987 through 1989 shows that, in keeping with Administration priorities, the President's budget request for strategic forces will grow more rapidly than the total defense budget request, perhaps pushing strategic funding above historical averages. Table 1 shows that the budget for strategic forces would grow in real terms by about 10 percent from 1987 to 1988 and by about 7 percent from 1988 to 1989. Under Administration plans and economic assumptions, the total DoD budget would grow by about 3 percent a year in real terms through 1992; thus the strategic share of that budget for strategic forces will increase from 11.9 percent in 1987 to 13.4 percent in 1989 (see Table 1).

Though projections are not publicly available, this trend toward higher growth could well continue over the five-year period from 1988 through 1992. Several major modernization programs--such as the small intercontinental ballistic missile and the Advanced Technology

Figure 1.
Strategic Forces as a Percentage of the DoD Budget



SOURCE: Congressional Budget Office based on data from the Department of Defense for 1962-1987. Data for fiscal years 1988 and 1989 are based on the President's budget request.

NOTE: Data reflect total obligational authority.

Bomber--are moving from the relatively less expensive stage of research into procurement. Higher growth also reflects increases in research on the Strategic Defense Initiative, which almost doubles in this period under Administration plans. The Secretary of Defense has stated in recent testimony, however, that the total budget for strategic forces would not exceed 15 percent of the tota! DoD budget for any year.

Despite planned growth in strategic costs, the Congress has indicated that it is not likely to provide the overall defense growth the Administration would like over the next three years and that it may continue reducing the defense budget. Depending on the level of tax increases, the budget resolution approved by the Congress would

TABLE 1. BUDGET FOR STRATEGIC FORCES
(In billions of 1988 dollars)

	1987	1988	1989
DoD Total Obligational Authority (TOA) a/	298.1	304.1	313.1
Strategic forces	35.6	39.2	42.1
(Investment) b/	(24.9)	(29.1)	(31.8)
Real growth (in percents)	n.a.	10.1	7.4
Strategic share of TOA (in percents)	11.9	12.9	13.4

SOURCE: Congressional Budget Office based on Department of Defense data.

NOTE: n.a. = not applicable.

Amounts are taken from Department of Defense, *Five-Year Defense Plan*. Includes supplemental appropriation in 1987. The budget for strategic forces includes funds for both offensive strategic forces and defensive strategic forces.

a. Total obligational authority (TOA) is a DoD financial term that measures the value of the direct defense program for a fiscal year. Net offsetting and trust fund receipts are not deducted from TOA as they are from budget authority (BA). They are collections from the public that arise out of the business-type or market-oriented activities of the government and are deposited in receipt accounts. In recent times, the differences between TOA and BA have been small.

b. Investment includes Procurement; Research, Development, Test and Evaluation; and Military Construction.

provide an average of between 1.0 percent and 2.4 percent real decline in the defense budget over the next three years. As a result of the juxtaposition of declining defense budgets and sharply increasing spending requirements for the strategic modernization program, the Congress will face some difficult choices in the years ahead. This study addresses those choices for strategic offensive forces.

CHAPTER II

ISSUES FACING U.S. STRATEGIC FORCES

The United States maintains three basic types of strategic offensive forces. This triad includes:

- Land-based intercontinental ballistic missiles (ICBMs);
- Submarines (SSBNs) armed with sea-launched ballistic missiles (SLBMs); and
- Strategic bombers and bomber-carried weapons, such as gravity bombs, short-range attack missiles (SRAMs), and air-launched cruise missiles (ALCMs).

Land-based missiles include the older Minuteman II and Minuteman III missiles, the MX (or Peacekeeper) missile currently being deployed, and a plan for a new, small intercontinental ballistic missile (SICBM). Sea-based forces include Poseidon submarines carrying Poseidon (C-3) and newer Trident I (C-4) missiles, and new Trident submarines currently carrying C-4 missiles but eventually planned to carry new Trident II (D-5) missiles. Strategic bomber forces include older B-52 bombers, which comprise the bulk of the force, a relatively small number of FB-111s, B-1B bombers currently being fielded, and a plan for an Advanced Technology ("Stealth") Bomber, also known as the B-2. Cruise missiles can be ground- , sea- , or air-based. Only air-launched cruise missiles carried by strategic bombers, however, are unambiguously considered strategic weapons. Appendix A describes the major types of U.S. forces included in each category.

Together, all of these forces provide the United States with roughly 12,000 strategic warheads today, up from about 9,000 in 1981.1/ Warheads for which funds have already been provided, but

1. These amounts include total inventories of ballistic missile warheads and bomber-carried weapons. Amounts in the Summary excluded weapons in the overhaul and maintenance pipeline.

that have not yet entered the inventory, will raise the number to over 14,000. Administration plans for additional increases in strategic spending will probably not add further to warhead levels, since older systems will be retiring, but will provide improvements in other measures of capability that are discussed more fully below.

COMPARISON OF CURRENT FORCE LEVELS OF THE UNITED STATES AND SOVIET UNION

As background for assessing the Administration's plans, it is useful to understand the current balance of strategic forces between the United States and its principal nuclear adversary, the Soviet Union, and how that balance has been affected by recent trends in modernization.

U.S. and Soviet Warhead Counts and Modernization

As Table 2 shows, the United States and the Soviet Union currently have similar numbers of total warheads, with the United States slightly ahead. The balance has not been static, however, even with arms limitations. Since 1981, the United States and the USSR have each added several thousand warheads to their strategic nuclear arsenals.

Moreover, both sides have modernized their forces. Between the late 1960s and early 1980s, the United States deployed relatively few new submarines, bombers, or land-based missiles that deliver nuclear weapons. But the United States did refit many existing systems with multiple warheads, thereby substantially increasing the number of its warheads. The United States also improved factors such as the range and accuracy of weapons. (The specifics of the recent U.S. modernization program are discussed more fully in Chapter III as background for current Administration plans.)

As part of its modernization, the Soviet Union has introduced many more new weapons systems than has the United States. Since the early 1960s, the Soviets have been building up their strategic

TABLE 2. UNITED STATES AND SOVIET STRATEGIC FORCES IN 1987

System	Launchers	Warheads per Launcher	Total Warheads
	United States		
ICBMs			
Minuteman II	450	1	450
Minuteman III	523	3	1,569
MX	27	10	270
Subtotal	1,000		2,289
SLBMs			
Poseidon (C-3)	256	10	2,560
Poseidon (C-4)	192	8	1,536
Trident (C-4)	192	8	1,536
Subtotal	640		5,632
Bombers			
B-52G	69	8	552
B-52G (With cruise missiles)	98	12	1,568
B-52H	49	10	490
B-52H (With cruise missiles)	49	12	784
B-1B	64	16	1,024
Subtotal	329		4,418 a/
TOTAL	1,969		12,339
	Soviet Union		
ICBMs			
SS-11	440	1	440
SS-13	60	1	60
SS-17	150	4	600
SS-18	308	10	3,080
SS-19	360	6	2,160
SS-X-25	100	1	100
Subtotal	1,418		6,440
SLBMs			
SS-N-6	272	1	272
SS-N-8	292	1	292
SS-N-18	224	3	672
SS-N-20	80	6-9	720
SS-N-23	64	10	640
Subtotal	932		2,596
Bombers			
Bear	100	4	400
Bear H	50	8	400
Bison	15	4	60
Subtotal	165		860
TOTAL	2,515		9,896

SOURCE: Congressional Budget Office estimates.
NOTE: Reflects total inventories. Does not include U.S. FB-111 and Soviet Backfire bombers.
a. Notional weapons carriage parameters, based on estimates of total inventories of bomber weapons. May slightly overstate inventories.

offensive and defensive forces, both in terms of quantity and capability per weapon. The centerpiece of their efforts has been their ICBM force. During the 1970s, for example, the Soviets developed and deployed three new ICBMs capable of carrying multiple warheads--including an ICBM with the most throwweight of any deployed missile, the SS-18. This trend is continuing in the 1980s, including the deployment of mobile missiles. Today, over 60 percent of Soviet warheads are concentrated in their ICBM force.

Most of the current Soviet submarine force is equipped with single-warhead missiles, and the Soviet strategic bomber force has not had the prominence of its U.S. counterpart. The Soviets, however, are continuing with modernization programs in the 1980s that will substantially expand their sea- and air-based forces.

Other U.S. and Soviet Pre-Attack Measures of Force Capability

As Figure 2 illustrates, the two superpowers possess a roughly even number of total warheads and a roughly even number of warheads capable of destroying hardened targets. 2/ (Appendix B discusses the measures and scenarios used in this analysis.) Unlike the United States, however, the Soviet Union has almost all its hard-target warheads on ICBMs. Ballistic missiles can be delivered to their targets within minutes while bombers take many hours. Although the intelligence community has recently reassessed its estimates of the accuracy of some Soviet ICBMs, their capability is still theoretically more than enough to destroy virtually all U.S. land-based missile silos.3/ Moreover, the Soviets may have an incentive to use

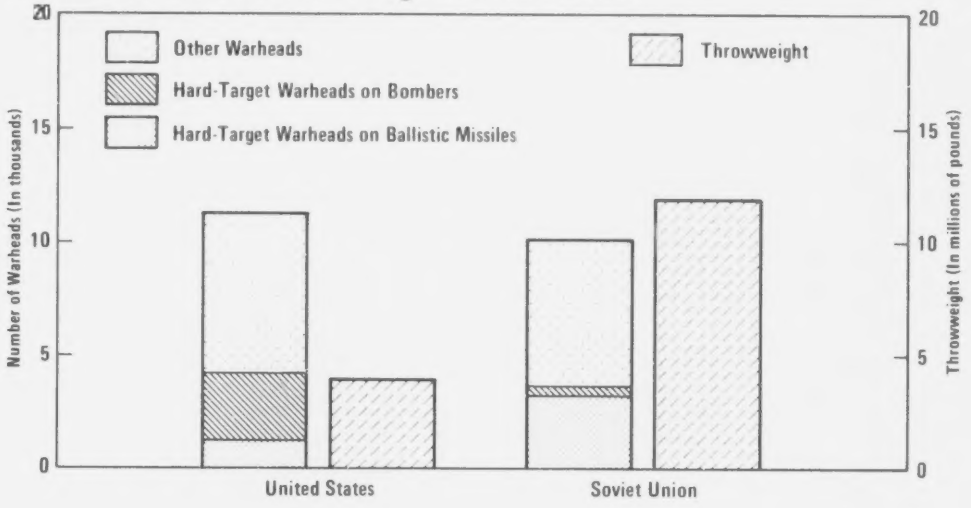
2. Figure 2 compares on-line weapons while Table 2 compares weapons inventories. On-line weapons are operational weapons not undergoing maintenance and repair; these weapons would be available to military planners in the event of nuclear war. All silo-based ICBMs are considered to be on-line. About 10 percent of the U.S. bomber force is in the "maintenance pipeline" at any time, and U.S. submarine overhauls and repairs are generally predictable and scheduled. This analysis assumes that about 20 percent of Soviet submarines are undergoing repair and overhaul at any time since a planned schedule cannot be constructed.

3. Whereas most of the multiple-warhead ICBMs deployed in the 1970s were considered capable of destroying hardened targets, the SS-18 and perhaps the new SS-25 are currently the only ICBMs considered to have significant capability against hardened targets. Compare *Soviet Military Power, 1984*, p. 23, and *Soviet Military Power, 1987*, p. 29. See also *National Journal*, July 20, 1985, p. 1692.

their ICBM warheads first in a crisis, since over 98 percent are currently based in fixed silos that could be vulnerable to a preemptive U.S. attack.

Compared with the United States, the Soviet Union has about three times as much throwweight, or payload capacity, in its land-based and sea-based ballistic missiles. Most Soviet throwweight is concentrated in its large and most accurate land-based missiles--the SS-18s. The Soviet lead in throwweight has raised concerns that they could surreptitiously increase the numbers or yields of warheads on these missiles. In the context of strategic defenses, it has also raised concerns about the leverage for deploying penetration aids and warhead decoys without having to make a trade-off in numbers of warheads deployed.

Figure 2.
Current U.S. and Soviet Strategic Forces in 1987



SOURCE: Congressional Budget Office estimates.
NOTE: Adjusted for on-line weapons.

Post-Attack Balance of Forces

A major objective of strategic force modernization efforts is to improve the survival prospects of current and future forces. Post-strike inventories not only measure expectations as to the survivability of U.S. forces, but also incorporate the capabilities of the attacking Soviet forces.

Figure 3 shows U.S. warheads surviving a Soviet nuclear attack that occurred after a period of marked tension or conventional hostilities during which time the nuclear forces of both sides would be brought to a war footing. This attack is described as one with strategic warning and is widely considered the most plausible scenario.4/ With very few surviving hard-target warheads on ballistic missiles, the United States would not be able to retaliate quickly in kind against remaining Soviet silo-based missiles. The U.S. bomber force would have about 2,600 surviving hard-target weapons, but the Soviets would have many hours to try either to coerce the United States into recalling them (by threatening further prompt attack) or to launch another attack before the bombers arrived. The other 5,600 surviving U.S. warheads would not have substantial capability against hardened targets.

Thus, in 1987, deterrence relies heavily on the fact that the Soviet Union unquestionably can be devastated by a U.S. retaliatory strike against targets less hardened against nuclear attack, and on the potential that the United States could launch its approximately 1,200 hard-target ICBM warheads before absorbing a Soviet attack, particularly in the scenario described above where a potential attack was anticipated.

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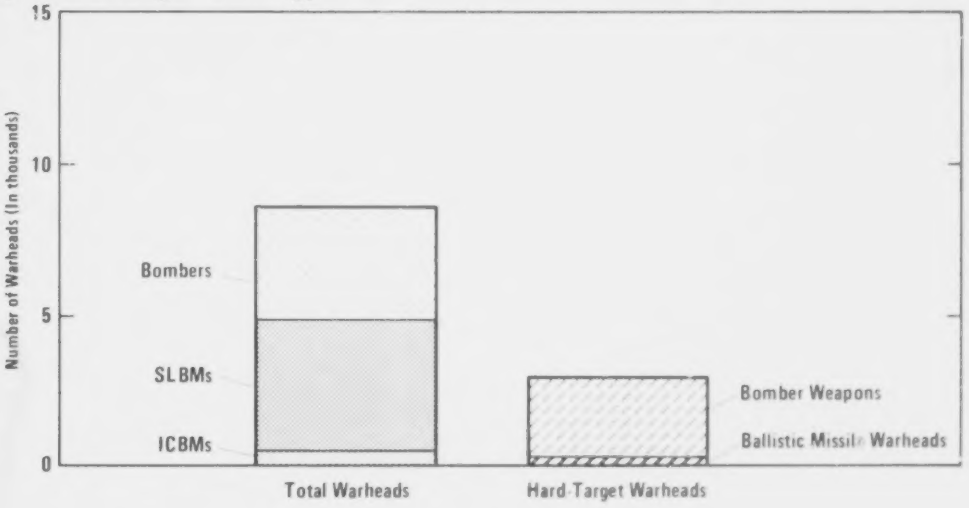
4. Strategic warning is evidence indicating the probability of an attack, or its preparation. It can range from an intelligence officer's assessment of activities of the leadership to photointelligence indicating a higher level of readiness or deployment of forces. Naturally, if the aim was truly to go to war, rather than use tactics for intimidation, the aggressor would attempt to mask the real nature of his activities.

PERSPECTIVES ON U.S. DETERRENCE STRATEGY AND ITS REQUIREMENTS

The primary mission of U.S. strategic forces is to deter the Soviet Union from initiating a nuclear war or from using its forces to coerce the United States or its allies into political decisions. Failing that, the mission of these forces is to impose unacceptable costs at the lowest possible level of escalation, forcing the Soviets to decide that halting their aggression is the best outcome.

Notions of how best to achieve deterrence have evolved in ways that have altered requirements for some types of nuclear weapons. The following sections describe the background for those changes and how they have influenced nuclear force requirements. Not everyone agrees with these changes, and one's choice of a strategy for deterrence influences decisions about how best to proceed with strategic modernization.

Figure 3.
U.S. Warheads Surviving a Soviet Attack in 1987
(With strategic warning)



SOURCE: Congressional Budget Office estimates.
NOTE: Adjusted for weapons available for retaliation.

Perspectives on Deterrence Strategy

Contrary to widely held perceptions, U.S. nuclear war plans supporting deterrent strategies have always included a wide range of types of targets. Furthermore, the general categories of targets have remained remarkably consistent: military forces, stockpiles, bases and installations; economic and industrial centers; and the Soviet nuclear forces and leadership.5/ The military objectives underlying nuclear targeting have also been consistent--to deny the Soviets the will or the ability to wage war effectively.

The priorities and emphases assigned to these categories of targets, however, have varied. In part, they have varied with developments in U.S. capabilities: greater supplies and types of weapons; improved intelligence for detection and identification of targets; and improved accuracies. In part, they have varied in reaction to Soviet efforts in both their conventional and nuclear forces and as a result of efforts to identify what would best deter them.

Although the specter of any use of nuclear weapons resulting in a massive, uncontrolled exchange of nuclear weapons between the United States and the Soviet Union remains the bedrock of deterrence and circumspection in the nuclear age, mutual suicide would most likely be the result of miscalculation rather than planning. United States nuclear forces are relied on to deter both a nuclear attack on the United States and a conventional attack on its allies. The latter poses the greater challenge.

Soviet interests, insofar as expanding territory and control are concerned, are much more likely to center on lands other than the United States--such as Western Europe, the Middle East, or Southwest Asia--posing a direct or indirect threat to the Alliance. On the basis of both U.S. deterrence policy and potential Soviet expansionist aims, the breakout of conventional hostilities in these areas is considered the most conceivable route to the use of nuclear weapons, and thus the most challenging for deterrence.

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5. Desmond Ball, *Targeting for Strategic Deterrence*, Adelphi Paper No. 185, IISS, 1983, p. 4.

Through the early-to-mid 1950s, clear U.S. superiority in nuclear forces credibly accomplished both objectives of deterring a nuclear attack on itself and a conventional attack on its allies. The United States could threaten a nuclear attack on the Soviet Union with relative impunity--knowing damage to itself would be far less than that inflicted on the Soviets. Furthermore, the scale of the threatened punishment would be grossly disproportionate to any gains the Soviets could have hoped for by initiating aggression.

In the 1960s, as the Soviet capacity for both nuclear and conventional attack grew, the credibility of the threat of massive nuclear response to a conventional attack eroded, since the United States would incur tremendous damage from a Soviet nuclear response. In 1967, after five years of debate, the United States and its allies in the North Atlantic Treaty Organization (NATO) adopted the concept of "flexible response." This concept had two important goals: to improve the conventional balance, thereby reducing U.S. and NATO reliance on nuclear weapons to deter or cope with non-nuclear attack, and to increase the flexibility and selectivity of U.S. nuclear response options in the hope of limiting escalation while convincing the Soviet Union that the price of continued aggression was too high. In the view of many analysts and policymakers, the former goal has not been met; the Alliance continues to rely heavily on a nuclear response even to non-nuclear aggression on the part of the Soviet Union.

The strategic nuclear balance forms an important background for the credibility of NATO's policy of flexible response. It is also important for deterring the Soviets from escalating a conventional war to a nuclear conflict. Against this backdrop, the Soviets have been consistently expanding both their strategic offensive and defensive capabilities. Within the past 10 years, they have more than quadrupled the number of nuclear weapons in their strategic arsenal--although current levels are similar to that of the United States. Moreover, they currently have under way a substantial modernization effort that will produce a new generation of weapons systems in all areas of their forces.

Improved accuracy of Soviet ICBM forces has seriously diminished the prospects for survival of U.S. land-based missiles, and extensive Soviet efforts in air defense have undercut the prospects for the retaliatory capability of penetrating U.S. bomber forces against their

air defenses. In addition, the Soviets have an unmatched civil defense effort. They have an extensive network of bunkers hardened against nuclear effects to protect their leadership, and have also made extensive plans to evacuate and protect their general population. These efforts have increased the perception in the last several Administrations that the Soviets may believe they could preserve what they value in a nuclear exchange--particularly a limited one--while causing the United States to pay an unacceptable price.

Perspectives on Nuclear Force Requirements

Changes in the balance of forces and dynamics of deterrence have led to shifts in what policymakers now believe is necessary to deter Soviet aggression. General agreement still exists that the United States must retain some basic parity with the Soviet Union in total numbers of strategic forces to avoid the appearance of weakness. But the Soviets appear to have placed an increasingly high value on their military assets and on protecting their leadership in the event of nuclear war. Policymakers are concerned that they have taken this approach both to improve their effectiveness in fighting a war and as leverage for political coercion short of war. Thus, U.S. targeting plans--especially since 1979-1980--have increased the priority of Soviet nuclear forces, other military forces, and leadership centers as targets regardless of the level of conflict. 6/

This emphasis is largely responsible for U.S. plans to add more warheads and to make a greater proportion of warheads able to attack hardened targets. Plans have also stressed the need for survivable and flexible forces. Survivable forces reduce the leverage to the agressor of conducting either a surprise attack or a prolonged war. 7/ Flexi-

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6. See D. Ball and J. Richelson, eds., *Strategic Nuclear Targeting* (Ithaca: Cornell University Press, 1986).

7. In any conflict, the command, control, communications and intelligence (C^3I) network of strategic forces bears some of the heaviest demands. Attack assessment, decision-making, and coordination are just some of its required functions. Strengthening C^3I has been an important focus of the modernization program and is the subject of a forthcoming CBO staff working paper. See also Ashton Carter and others, eds., *Managing Nuclear Operations* (Washington, D.C.: The Brookings Institution, 1987).

ble forces allow the United States to respond appropriately to a variety of contingencies.

Efforts along these lines to strengthen deterrence precede the current Administration, as do many of the programs involved in current U.S. strategic modernization. The debate has sharpened, however, because of recent heavy investments in and future commitments to strategic forces, and because of the current Administration's statements that the Soviets have superiority in important strategic capabilities.

Disagreements Over Current U.S. Deterrence Strategy

Many analysts do not agree that changes in strategic doctrine, especially those accompanying demands for more and better weapons, are needed to deter nuclear war. Some even disagree that such changes enhance nuclear deterrence. One concern of these critics is that emphasis on investment in U.S. strategic nuclear forces erodes the goal of strengthening conventional forces. In their view, a commitment to conventional forces is of equal or greater importance in enhancing deterrence since, in a war, weakness in conventional forces could increase the chances for using nuclear weapons.

Another concern is that a strong focus on targeting an opponent's nuclear forces makes force requirements self-perpetuating if both sides follow this strategy. By the time the United States adds sufficient capability to attack promptly many Soviet missile silos, submarine and bomber bases, and hardened leadership and command centers, the Soviets may have hundreds of new mobile strategic missiles, which would require additional and completely different U.S. capabilities for targeting, such as additional bombers and bomber-carried weapons, or many low-altitude satellites and extensive retargeting capabilities for ICBMs.

Nor is the issue simply one of resources. Targeting an opponent's forces presents potentially serious problems for controlling a crisis. For instance, the Administration and many military planners believe it is important to target Soviet ICBMs in response to a Soviet attack. They believe it would be imprudent to allow the Soviets to believe they could retain ICBMs--not used in an initial attack--as a secure reserve force or to threaten further attacks. This targeting strategy, however,

carries great risks. If a conflict was already under way, the Soviet Union would probably launch its remaining ICBMs once it learned of a U.S. retaliatory attack, thus increasing damage to the United States and expanding the size of the war.

To put it another way, a crisis between nuclear powers is less likely to arise if each nation has well-protected weapons systems, resulting in little incentive either for a potential aggressor to attack or for the defender to launch its missiles on warning of an attack. Placing priority on targeting nuclear forces creates continual stress for crisis stability. For instance, current plans to increase U.S. ability to target Soviet forces require the addition of large numbers of hard-target warheads. If the Soviets also deploy hard-target capability more widely, perhaps as a result of the U.S. increase, it could jeopardize U.S. efforts to deploy survivable forces, particularly to increase ICBM survivability.

The potential impact of these efforts can be illustrated with the small, mobile ICBM system the United States plans to deploy. The purpose of this system is to provide the United States with survivable land-based missiles, thus reducing both the incentive for the Soviets to attack and the pressure to "use or lose" the U.S. silo-based ICBM force. Opponents of the system argue that the SICBMs would not increase survivability because the Soviets could attack the system with close-in submarine-launched missiles (SLBMs), launched at the same time as Soviet ICBMs so that there would be no advance warning of the SLBM attack. The submarine-launched missiles would arrive much sooner than the ICBMs, allowing much less time for U.S. SICBM missiles to be dispersed, and greatly reducing their survivability.

Today, however, that sort of attack on the part of the Soviet Union would not make much military sense. Soviet submarine-launched missiles may be able to attack a softer target like SICBMs, but without hard-target capability they cannot attack the silo-based ICBMs--a much more formidable force in terms of retaliatory capability. In fact, a Soviet planner would be unwise to believe that the United States would be reluctant to launch its silo-based missiles in the face of actual nuclear detonations on American soil, were Soviet SLBMs to

attack U.S. SICBMs.8/ Therefore, under such a scenario, the Soviet planner would be virtually guaranteeing retaliation by one thousand multiple-warhead missiles for the benefit of destroying several hundred single-warhead ICBMs.

Whether that scenario would be so implausible in the future is, however, another issue. The addition of large quantities of hard-target capability to the Soviet submarine force, similar to current U.S. plans and simply a matter of time, may alter this trade-off in a most unfavorable way. This possibility emphasizes the risks some analysts see in U.S. deployments of hard-target warheads to target Soviet forces.

Proponents of hard-target capability counter that, even if the United States showed restraint in its deployment of hard-target capability, the Soviets would not and that the United States would then find itself in a position even weaker than today. The Soviets can currently threaten the survivability of the U.S. silo-based ICBM force without facing similar retaliation (unless the United States takes the risky step of launching its forces on-warning of attack). Opponents argue in turn that arms control should be the vehicle for addressing such concerns. They believe that it is possible to limit the numbers and types of weapons so that each side has relatively secure forces and that it would be in the interests of both countries to avoid expending more and more effort to achieve survivable forces.

This report cannot resolve these fundamental philosophical differences. Rather it presents options that are consistent with some differences in views. Nor does the paper try to measure directly the deterrent capability of the Administration's program or of alternatives to it. As this discussion suggests, deterrence involves nuances of strategy that cannot be measured. Instead, this report estimates the effects of different programs in terms of changes in strategic weapons inventories, a method of judging capabilities that is commonly used by the Department of Defense.

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8. The silo-based missiles would be launched "under attack"--that is, after actual nuclear explosions on U.S. territory. This situation is different from launching "on warning" of a Soviet attack, which poses the possibility for error by U.S. radar warning facilities.

CHAPTER III

COSTS AND EFFECTS OF THE ADMINISTRATION'S MODERNIZATION PROGRAM

Three key goals seem to underlie the Administration's plans for continued modernization of strategic offensive forces: maintain a survivable triad, respond flexibly to a Soviet attack, and maintain a manned penetrating bomber.1/ Under reasonable assumptions about the Soviet Union's future plans for its force structure, this plan would alter the balance of forces between the United States and Soviet Union in a manner consistent with these goals, and would give strategic forces an increasing share of future defense budgets.

GOALS OF CONTINUED MODERNIZATION

The three goals serve to describe and organize Administration plans. While the goals did not originate with this Administration, it has clearly subscribed to them more than any recent Administration. As discussed in Chapter II, not all analysts agree with the goals; some hold quite different views on what is necessary and desirable for the posture of U.S. deterrent forces.

Maintain a Survivable Triad

To a large degree, the scope of the Administration's planned buildup is driven by an effort to maintain a survivable triad of strategic forces and thus to continue to foil Soviet efforts to defeat U.S. retaliatory capability. The United States currently relies on a triad of strategic nuclear forces--land-based ballistic missiles, bombers, and submarine-launched ballistic missiles. A survivable triad enhances deterrence in several ways. It complicates Soviet efforts in planning and executing an attack; with three types of forces, the Soviets cannot focus their

1. The Administration also has key goals with respect to C^3I and strategic defenses.

attack on one type. A survivable triad also lessens the value of Soviet success in putting one leg of the triad at risk. Thus, the Soviets cannot afford to concentrate all their research and development efforts on one problem. The triad also provides a hedge against an unforeseen technical failure of an entire weapons system.

In addition, some segments of the triad reinforce each other in the face of a Soviet attack. For example, because of the timing required in an attack, the bombers and ICBMs together are more survivable than either would be alone.2/ Finally, each component of the triad has unique strengths and weaknesses in terms of survivability, flexibility, endurance, and reliability of command and control (see Appendix A).

Respond Flexibly to a Soviet Attack

Another goal of the modernization program is to increase the numbers of weapons that could survive a Soviet attack, retaliate promptly against selected targets (emphasizing hardened Soviet strategic forces and leadership facilities), and endure for some time after an initial exchange of weapons. A Soviet attack against U.S. strategic forces--termed a counterforce attack--is generally considered the most demanding for a U.S. retaliatory response. Currently, U.S. weapons able to retaliate against this select group of hardened targets could be the least survivable in the event of a Soviet attack.

This goal reflects the belief that the Soviets most value their tools of control and power (that is, strategic forces and leadership facilities) and that therefore an effective response--at any level of conflict--must

2. Once bombers on alert are airborne for a few minutes, they are extremely difficult to attack. If the Soviet Union attempted a quick attack with missiles from submarines near the U.S. coast, it would provide about 15 minutes in which the formidable U.S. silo-based ICBM force could be launched under confirmed attack but before ICBMs from the USSR could arrive to attack them. (Without hard-target capability, SLBMs could not attack ICBM silos.) Conversely, if the Soviet Union waited until its ICBMs arrived to begin barraging the bombers, most of the planes would survive, although they would still have to face Soviet air defenses. The synergism between the new, mobile ICBM systems and the silo-based ICBMs would be similar, since the dispersal area of the mobile force increases rapidly with time. Furthermore, the Soviets might have to make some trade-offs in barraging bombers and the mobile ICBMs, increasing the survivability of one or the other.

emphasize these targets, most of which are hardened. It further reflects the belief that any significant imbalance between Soviet ability to destroy these types of targets in the United States and U.S. ability to retaliate symmetrically weakens deterrence.

Maintain a Manned Penetrating Bomber

Because the Soviets have devoted considerable resources to building and operating air defense radars, missiles, and aircraft, the Administration planned a bomber modernization program to procure two new strategic bombers, the B-1 and Advanced Technology Bomber (ATB or B-2), to maintain bomber penetration capabilities while moving the older B-52 force away from penetrating missions. Current plans involve equipping these aircraft with cruise missiles that would be launched from bombers outside Soviet airspace and fly to their designated targets within the Soviet Union. Initially, the cruise missiles will be used in a mission that also involves bomber penetration with short-range weapons--a so-called shoot-penetrate role. By the mid-1990's, all B-52s will be in a pure standoff role; that is, carrying only cruise missiles. As the ATB is fielded, the B-1Bs will take on a shoot-penetrate role.

The Administration has placed a high priority on maintaining a manned penetrating bomber--the Advanced Technology Bomber--which is difficult to detect on radar and so should be better able to penetrate the Soviet Union, in the latter part of the century.

Although it is arguable whether having such a bomber is a distinct goal; neither of the above goals requires a manned penetrating bomber, per se. Bombers on alert, even current bombers, have excellent chances for survival in an initial Soviet attack on U.S. bomber bases. Similarly, large numbers of ALCMs--launched from nonpenetrating bombers--can provide a great deal of flexibility and hard-target capability for the retaliatory mission. The Administration, however, believes that manned bombers must penetrate the Soviet Union to accomplish certain missions.

One key mission that requires a manned bomber is to find and destroy mobile targets, such as mobile ICBMs. With current technology, locating and destroying these targets requires a human

search. According to the Commander-in-Chief of the Strategic Air Command, manned bombers are also useful for assessment of target damage and "mop-up" target coverage. In addition, bombers in general--and the stealth bomber in particular--could provide versatile conventional capability in the face of improving air defenses in potential areas of conflict.3/

THE ADMINISTRATION'S MODERNIZATION PROGRAM FROM 1981 TO 1987

To support these goals, the Administration has undertaken a substantial buildup in U.S. strategic forces. Between fiscal years 1981 and 1987, the United States will have paid for procurement of:

- 100 B-1B bombers;
- 1,490 air-launched cruise missiles (ALCMs)--for a total of 1,739--and a classified number of advanced cruise missiles (ACMs);
- 6 Trident submarines (for a total so far of 14) plus 21 new Trident II (D-5) missiles; and
- 66 MX missiles (including test missiles).

At least one system has been procured for each leg of the triad, suggesting the importance to the Administration of the first goal: maintain a survivable triad. The ability to retaliate against hardened targets may also be enhanced by the purchase of 50 MX missiles, although they will be deployed in fixed silos. The Trident II missile--another system just entering procurement--will clearly support this goal as it is deployed, beginning in the late 1980s. Finally, the United States has also purchased the B-1B, a new manned penetrating bomber, consistent with its third goal.

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3. Testimony of General Welch before the Senate Committee on Armed Services, *Department of Defense Authorization for Appropriations for 1987*, Part 4, pp. 1600-1601.

Quantitative measures of the buildup to date also bear out support for the three goals. Table 3 compares actual 1981 forces with actual 1987 forces, showing an increase in total warheads of 36 percent. Since actual deployment of a weapons system can follow procurement by several years, some of the systems bought in recent years are not yet in the force. In fact, the fourteenth Trident submarine--the system with the longest lead time--will not be deployed until September 1993. Thus, Table 4 shows a "funded" force that assumes everything purchased to date is in the inventory. Both funded and deployed forces show increases in total warheads in all three legs of the triad. Funded forces in 1987 have a total of about 3,000 more warheads than was the case in 1981--14,245 compared with 11,361. Growth in total warheads in the forces actually deployed is slightly greater but with lower absolute levels.

Growth in hard-target kill (HTK) capable warheads is much more pronounced than growth of total warheads, reflecting the importance of the second of the three goals. Hard-target warheads grow 123 percent from 1981 to 1987 in the funded forces--from 2,896 HTK-capable warheads to 6,463. Deployed forces show a slightly smaller

TABLE 3. DEPLOYED U.S. STRATEGIC FORCES: 1981 AND 1987

	ICBMs		SLBMs		Bombers		Total	
	1981	1987	1981	1987	1981	1987	1981	1987
Warheads	2,153	2,288	4,576	5,632	2,312	4,404	9,041	12,325
Hard-Target Kill (HTK) Capable Warheads	900	1,170	0	0	1,212	3,304	2,112	4,474
Percent Contribution to Total Triad HTK Warheads	43	26	0	0	57	74	n.a.	n.a.
Throwweight (In millions of pounds)	2.5	2.2	1.6	2.0	n.a.	n.a.	4.1	4.2

SOURCE: Congressional Budget Office based on data from the Department of Defense.

NOTE: n.a. = not applicable. These numbers represent inventory counts of weapons.

increase of about 112 percent in hard-target warheads--from 2,112 to 4,474.

While all legs of the triad grow, the percentage contribution of each leg changes during the 1981-1987 period. Among funded forces, HTK-capable warheads on bombers and land-based missiles increase significantly, but growth in sea-based HTK-capable warheads is most pronounced--reflecting the deployment of new Trident II warheads aboard the ninth through fourteenth Trident submarines. On the other hand, in the active deployed force, the sea-based component makes no contribution to HTK capability in either 1981 or 1987. Among the deployed forces, growth in the contribution of bomber HTK capability is most pronounced. Bombers carried about 57 percent of hard-target capability in 1981. By 1987, they carry about 75 percent of that capability, largely reflecting the installation of air-launched cruise missiles.

TABLE 4. FUNDED U.S. STRATEGIC FORCES: 1981 AND 1987

	ICBMs		SLBMs a/		Bombers b/		Total	
	1981	1987	1981	1987	1981	1987	1981	1987
Warheads	2,153	2,450	6,304	6,784	2,904	5,011	11,361	14,245
Hard-Target Kill (HTK) Capable Warheads	900	1,400	192	1,152	1,804	3,911	2,896	6,463
Percent Contribution to Total Triad HTK Warheads	31	22	7	18	62	60	n.a.	n.a.
Throwweight (In millions of pounds)	2.5	2.3	2.3	2.8	n.a.	n.a.	4.8	5.1

SOURCE: Congressional Budget Office based on data from the Department of Defense.

NOTE: n.a. = not applicable.

a. New submarine-launched missiles (D-5) for the ninth to thirteenth funded Trident submarines will actually be procured through 1989. However, because the submarine is funded and the missiles will be available as the submarines are actually deployed, they are included here. They are counted as carrying 8 Mark 5 warheads; they could carry 12 Mark 4 warheads.

b. CBO estimates 240 ACMs are funded through 1987 based on press reports and ALCM production rates.

U.S. AND SOVIET MODERNIZATION PLANS BEYOND 1987

Although the buildup to date has been substantial, both the United States and the Soviet Union have ambitious modernization plans for the future.

United States

Under the modernization plan, to support its three goals, the Administration would continue to procure several major weapons systems through the mid-to-late 1990s. While not all the details of the plan are available publicly, nor, in some cases have ultimate force levels been determined, this study assumes the modernization plan includes:

- Deployment starting in the early 1990s of 500 new, single-warhead, small ICBMs (SICBMs) in a mobile basing mode designed to survive a Soviet attack with tactical warning;4/

- Deployment, by the mid-1990s, of 50 MX missiles on railroad cars to achieve survivability with strategic warning;

- Deployment in the early to mid-1990s of 132 Advanced Technology Bombers ("stealth bombers") designed to penetrate the Soviet Union without being detected by radar;5/

- Deployment by the early 1990s of about 3,200 air-launched cruise missiles (ALCMs), with about 1,500 of those being Advanced Cruise Missiles (ACMs) that reportedly have greater range than earlier versions and are "stealthy" to air defense radars. Cruise missiles would be carried initially on B-52s

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4. Tactical warning is information from sensors that an attack was actually under way; ballistic missiles launched from the Soviet Union could begin destroying targets in about 30 minutes. The United States relies on a number of different sensors, space-based and ground-based, and on "dual-phenomenology," meaning independent confirmation from at least two sensors.

5. For quantities and costs, see quote from Secretary of Defense Weinberger in the *Washington Post*, June 4, 1986, p. 16, and report of an independent assessment by the General Accounting Office in *Defense News*, April 14, 1986, p. 1.

and would eventually be carried on both B-52 and B-1B bombers;

- Procurement through the mid-1990s of about 1,600 new nuclear short-range attack missiles (SRAM II) to replace the current aging missiles carried on penetrating bombers;

- Continued procurement through 1993 of Trident submarines at the current rate of one per year to a total of 20, and deployment by 1996, on most Trident submarines of the new, larger, and more accurate Trident II (D-5) missile.6/

Appendix A describes these systems in more detail.

Two characteristics of these new systems stand out. To some degree, all are mobile platforms, which should greatly enhance their survivability. Mobile platforms can move about over large areas, which makes them difficult to destroy. The second key characteristic is that all are hard-target capable weapons; these weapons would more than double the U.S. inventory of hard-target warheads by 1996.

Furthermore, modernizing all triad elements over a number of years would provide open production lines for manufacturing additional systems should that be necessary. Finally, modernization would decrease the average age of U.S. forces and equipment, presumably improving their reliability and maintainability. In 1996, for example, about 70 percent of bomber weapons would be carried by aircraft less than 15 years old, compared with less than 20 percent today.

Soviet Union

The Soviets also have ambitious modernization plans under way. They now are developing a follow-on missile to the SS-18 ICBM, and

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6. The President's budget for fiscal years 1988 and 1989 reflects procurement of the nineteenth Trident submarine in 1992. See also testimony by Rear Admiral Williams before the Senate Committee on Armed Services, "Strategic Force Modernization Programs," October/November 1981, pp. 170 and 173, to the effect that Navy studies consistently lean toward two squadrons, each consisting of 10 submarines.

are introducing two new ICBMs--the mobile SS-25 and the SS-24, which is expected to be deployed in both fixed and rail-mobile modes. They also have two strategic nuclear submarines in production--the Typhoon and the Delta IV--and are developing modified versions of the SS-N-20 and SS-N-23 multiple-warhead SLBMs deployed on these submarines. A new type of submarine is expected in the 1990s. The Soviet bomber force is also being modernized. A new version of the older model Bear-H bomber that carries the cruise missile (the older model did not) is in production. Testing of the Blackjack-A bomber also continues, although the Blackjack's deployment has been slower than U.S. analysts anticipated.7/

According to testimony by representatives of the Central Intelligence Agency (CIA), the number of deployed Soviet warheads is likely to grow to over 12,000 by 1990. If recent trends continue, the Soviets could deploy over 16,000 warheads by 1996, even if they maintained a moderate pace of modernization; a robust, but not maximum, pace of modernization could increase that number to over 21,000. DOD also projects that the Soviet ICBM force--the mainstay of their strategic forces--will be replaced almost entirely with new systems by the mid-1990s.8/ (See Appendix D for specific assumptions about Soviet forces.)

HOW THE BALANCE OF FORCES MIGHT CHANGE UNDER THE MODERNIZATION PLANS

Assuming a moderate pace of modernization by the Soviets, the U.S. buildup yields a shift in the balance of forces generally in keeping with the three key Administration goals discussed at the beginning of

7. The Backfire bomber is also in production, but is not usually considered a strategic bomber. It can reportedly be equipped for inflight refueling. The Soviets, however, reportedly have fewer than 100 aerial refueling tanker aircraft, although a new version has recently begun to be deployed. In contrast, the United States has over 600 tanker aircraft.

8. See "Soviet Strategic Force Developments," testimony of Robert M. Gates and Lawrence K. Gershwin, before a joint session of the Subcommittee on Strategic and Theater Nuclear Forces, Senate Committee on Armed Services, and the Defense Subcommittee, Senate Committee on Appropriations, June 26, 1985.

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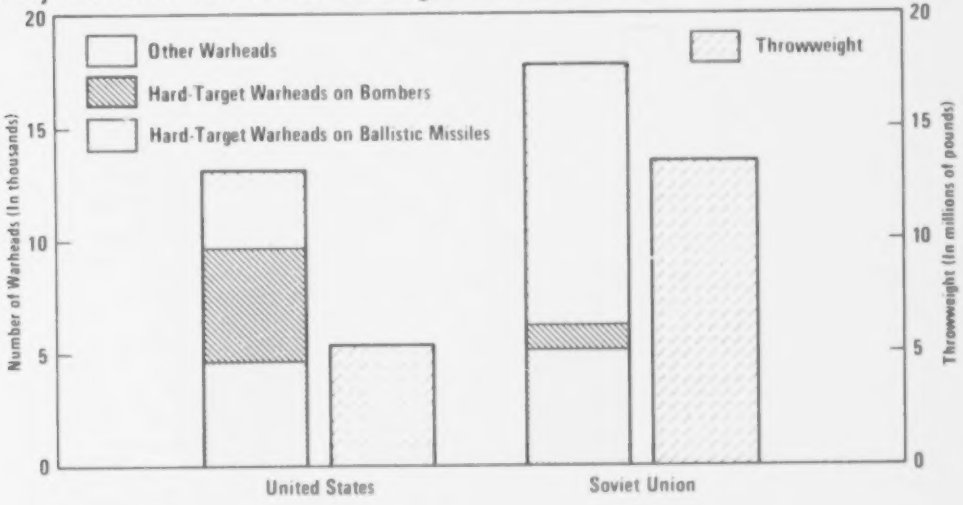
this chapter. The following review of quantitative measures of the future balance suggests this finding.

Pre-Attack Measures of Balance

Total Warheads. The rough balance of U.S. and Soviet warheads shifts in favor of the Soviet Union. As illustrated in Figure 4, by 1996 total numbers of U.S. on-line warheads will have increased from a 1987 level of about 11,200 to about 13,100. Assuming a pace of modernization consistent with recent efforts, total Soviet warheads will increase to about 17,700. Thus, the Soviets would have about 4,700 more warheads than the United States.

Hard-Target Warheads. While the balance of total warheads could shift in favor of the Soviet Union, the balance of hard-target warheads could shift in favor of the United States. U.S. hard-target warheads

Figure 4.
Projected U.S. and Soviet Strategic Forces in 1996



SOURCE: Congressional Budget Office estimates.
NOTE: Adjusted for on-line weapons.

would increase from about 4,100 in 1987 to about 9,600 by 1996, a growth of 134 percent. They would peak after 1996 at a level of about 11,600 as all Trident submarines were deployed, making a total increase of about 183 percent. This buildup in hard-target capability would occur largely because of the deployment of large numbers of cruise and SRAM II missiles on bombers and the deployment of Trident II missiles--the only hard-target capable missiles aboard submarines. The number of Soviet hard-target weapons could also increase significantly. Soviet hard-target warheads could increase from about 3,600 to about 6,000. By these measures, however, the United States would have substantially greater numbers of hard-target warheads by 1996.9/

Numbers of hard-target warheads capable of being delivered promptly, which exclude those on bombers, would also shift in favor of the United States. U.S. numbers would increase from about 1,200 in 1987 to about 4,600 by 1996--an increase of 283 percent.10/ Soviet prompt hard-target warheads could increase from about 3,200 to about 5,000.

Other Measures. The Soviet advantage in throwweight would decrease from about 3-to-1 in 1987 to about 2.5-to-1.0 by 1996. It is unlikely to fall further unless the Soviet Union elects to retire its large land-based missiles (particularly SS-18s), which appears improbable. Also, both the United States and the Soviet Union would probably increase the number of hard-target warheads in fixed locations, and those warheads are the most vulnerable to a nuclear attack. As a percentage of total prompt hard-target warheads, however, they would decrease in the United States from 100 percent today to about

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9. These figures incorporate a different assumption about Soviet ICBM hard-target capability than an earlier CBO analysis. Public estimates indicate that the new SS-24 is not hard-target capable, as do recent public estimates of the SS-17 and SS-19 ICBM's capability. These estimates account for the fact that U.S. silos are reportedly only hardened to about 2,000 psi. More accurate versions of the SS-24 and SS-25 are expected, according to *Soviet Military Power*, but do not appear to be incorporated into projections of the Soviets' mid-1990s forces. A new "heavy ICBM" (an SS-18 follow-on) is projected for the mid-1990s.

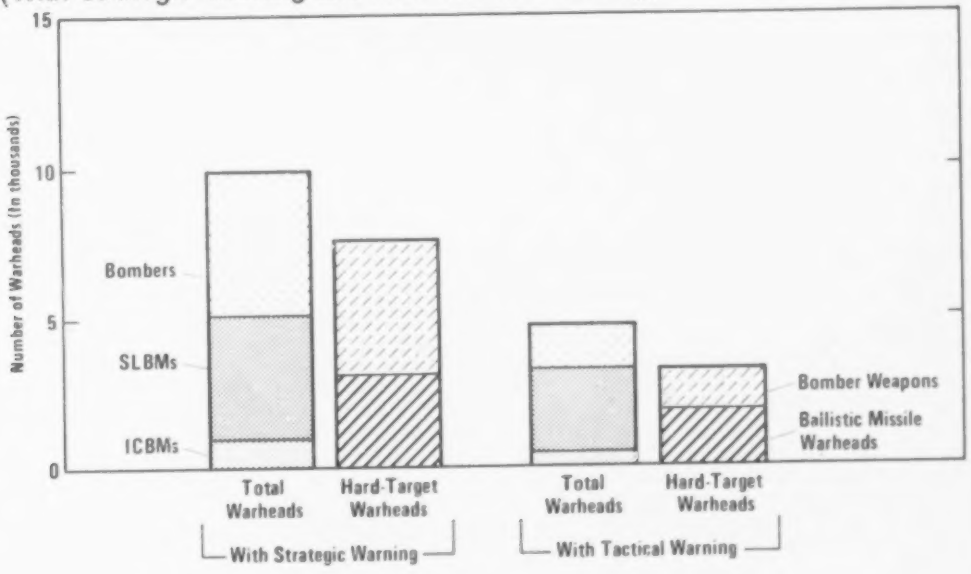
10. This total counts all SLBMs as prompt. This is a reasonable assumption for the most likely case of a Soviet attack with strategic warning.

30 percent. For the Soviets, the percentage, which is close to 100 percent today, would decline only to about 85 percent.

Post-Attack Measures of Balance

Results also shift sharply for the United States under measures that assume a counterforce attack--that is, an attack in which the Soviets try to destroy U.S. strategic forces. As Figure 5 shows, by 1996, in the most likely scenario of an attack that occurred with strategic warning, the United States would have about 9,900 surviving warheads available for retaliation, more than three-quarters of which would be capable of attacking hardened targets. The subset of these weapons available for an immediate retaliatory attack would total about 3,000. This contrasts sharply with the situation today, when the United States

Figure 5.
U.S. Warheads Surviving a Soviet Attack in 1996
(With strategic warning and with tactical warning)



SOURCE: Congressional Budget Office estimates.
NOTE: Adjusted for weapons available for retaliation.

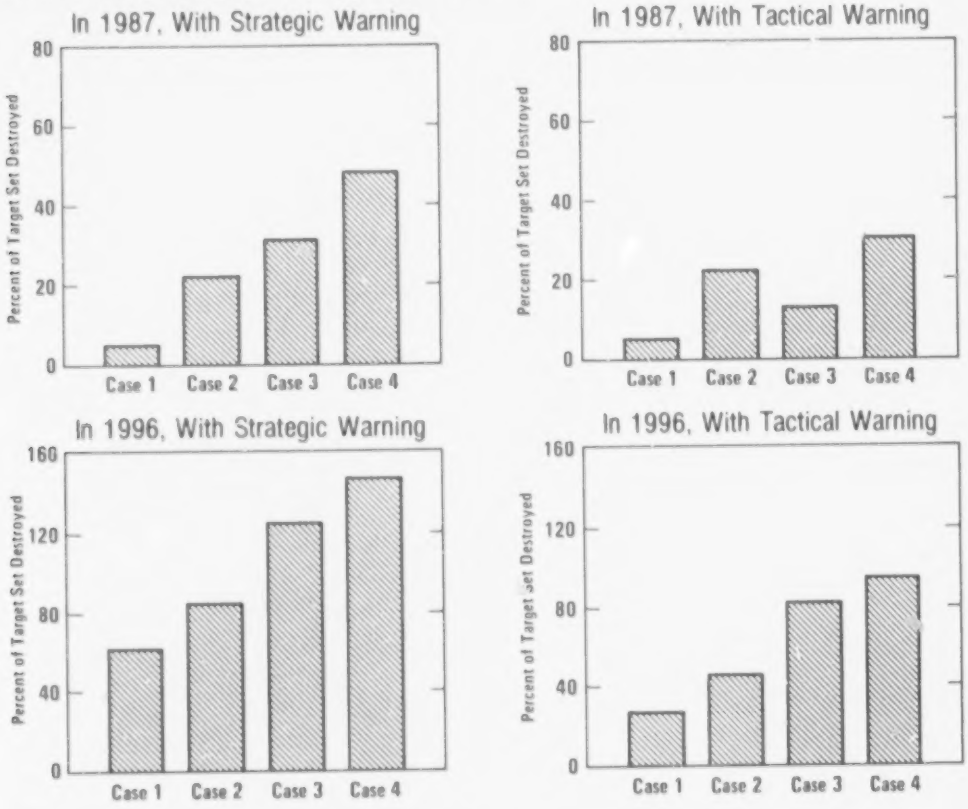
would likely have very little prompt HTK capability if it absorbed a Soviet attack before retaliation. After a surprise attack (tactical warning only), the subset of hard-target warheads available for prompt retaliation would be considerably smaller, about 800 warheads. Two factors primarily contribute to this result. First, virtually no rail-mobile MX missiles are assumed to survive such an attack. Second, in peacetime only about one-third of the strategic submarines at sea are on a prompt alert status, ready to receive a launch order and execute it promptly. Another one-third are on modified alert--that is, required to be able to react within a specified period of time; others may be conducting training exercises or be in transit, for instance.

What do these numbers of surviving hard-target capable weapons mean for U.S. retaliatory capability, particularly for the Administration's goal of increasing U.S. capability to hold at risk a significant portion of hardened Soviet strategic forces and leadership facilities? The Soviets have 1,318 ICBM silos. According to the DoD's *Soviet Military Power*, 818 of these silos are considered very hard. In addition, the Soviets may have between several hundred to several thousand hardened command and control centers and leadership bunkers, plus several hundred other strategic force targets. Only a fraction of these targets are likely to require prompt retaliation on the part of the United States.

Figure 6 shows the change in performance of U.S. retaliatory forces against a set of 2,000 very hard targets. This number probably represents a major portion of the set of Soviet hard targets.11/ In all cases, representing a range of scenarios for the U.S. force posture and retaliation, there is a major increase in U.S. capability against this set

11. Former Secretary of Defense Harold Brown has the following observation in his book, *Thinking About National Security: Defense and Foreign Policy in a Dangerous World* (Boulder, Colo.: Westview Press, 1983). "The United States must maintain hard-target capability. . . to ensure perception of a U.S.-Soviet strategic balance by being able to put at risk many hard targets of value to the Soviet leaders. . . . To this end, 1,000 to 2,000 warheads with prompt hard-target capability would be sufficient. The purely military advantages of prompt capability over delayed capability are modest, but they include a rapid response in kind to a Soviet attack on U.S. missile silos and a more effective ability to attack a Soviet political leadership that is being shuttled among hardened command posts." Note that this would represent a target set of at most 2,000 facilities, since some if not many targets could require more than one warhead.

Figure 6.
Performance of U.S. Retaliatory Forces Against An Illustrative Set of Soviet Hard Targets, in 1987 and 1996



SOURCE: Congressional Budget Office estimates.

NOTE: All figures represent the performance of on-line U.S. hard-target capable warheads against an illustrative target set consisting of 2,000 targets hardened to 5,000 psi. The calculations are based on the assumption that no more than two warheads are allocated against any one target. Calculations include adjustments for weapon reliability and, in the case of bomber weapons, ability to penetrate.

CASE 1: Prompt ballistic missiles only. U.S. absorbs a Soviet attack before retaliating. In the case of strategic warning, all ballistic missiles are considered to be on prompt alert status. In the case of tactical warning, only about one-third of SLBMs at sea are on prompt alert status—that is, ready to receive and execute a launch message within minutes.

CASE 2: Prompt ballistic missiles only. U.S. launches its silo-based ICBMs before absorbing a Soviet attack, but after indication an attack was under way.

CASE 3: All ballistic missiles and bomber weapons. U.S. absorbs a Soviet attack before retaliating.

CASE 4: All ballistic missiles and bomber weapons. U.S. launches its silo-based ICBMs before absorbing a Soviet attack, but after indication an attack was under way.

of targets. (This trend would continue beyond 1996 as the SICBM and Trident II were fully deployed). The overall capability of the force is also presumably increased since less capable weapons, which were targeted against very hard targets, could be reallocated to targets against which they have a much higher probability of destruction.

Although some analysts would argue that this situation implies that the United States has an excess of hard-target warheads, the limitations of the aggregate analysis here preclude this conclusion. Because the nature of nuclear war is uncertain, planners and policymakers have generally moved in the direction of having forces available to support a wide range of options, although not all would necessarily be used. Some groups, such as the Administration and many military planners, argue that if deterrence is to be credible, the United States must have the capability to hold at risk a major portion of military, leadership, and command and control facilities. Furthermore, the Soviet Union has an extensive military and civil defense network and, with dispersal, the number of potential hardened targets may increase significantly. As discussed in Chapter II, other groups argue that the drawbacks involved in deploying large amounts of hard-target capability to attack an opponent's forces outweigh the advantages. They further argue that other types of targeting--against the "softer" economic and industrial infrastructure, for instance--would exact a heavy enough price on the Soviets that it would act as a strong deterrent.

Effects of a Robust Soviet Modernization Effort

The preceding analysis assumes continuation of the recent trends in the Soviet pace of modernization. Testimony of the CIA, cited earlier, points out that with a greater commitment of resources, but not a maximum effort, the Soviets could have about 21,000 deployed warheads by the mid-1990s.

How might U.S. goals be affected if the Soviets pursue a robust expansion of their forces? In this case, the Soviets might have about 18,000 ballistic missile warheads, and about 5,400 prompt hard-target capable warheads. The United States would clearly be worse off than if the Soviets do not expand their forces, but basic trends toward meeting U.S. goals would not be altered.

The survivability of one of the three main segments of U.S. strategic forces--submarines, which are a major contributor of both survivable and hard-target capable warheads in the mid-1990s--is unlikely to be significantly affected by an increased number of warheads. Unless the Soviet Union were to achieve a technological breakthrough--which could occur independent of an expansion--U.S. submarines at sea should remain essentially invulnerable.

Nor are the extra Soviet warheads apt to threaten significantly U.S. bombers that are on alert and so are ready to take off within minutes of receipt of warning; the key to destroying alerted bombers is warheads that arrive very quickly. Large numbers of quickly arriving submarine-launched warheads might allow the Soviet Union to barrage the airspace around U.S. bases more effectively in an attempt to destroy bombers, but this does not seem to be likely for several reasons. First, bombers at inland bases have additional time to react before SLBMs arrive, and over time a higher percentage of the bomber force will be at these bases. Also, measures such as additional dispersal could be taken to protect the bomber force; however, such measures, if permanent, could be costly. Second, Soviet operational practice has been to keep their newer, longer-range submarines closer to their own territory, indicating a different mission for these forces and decreasing the threat of a barrage attack. Finally, barraging airspace is a challenge even with a very large number of warheads.

The survivability of fixed missile silos may further decrease, although since they are currently a very high-priority target, the difference is likely to be marginal. The Soviets, if they chose to, could more effectively barrage the mobile land-based forces--SICBM and Rail MX in a garrisoned basing mode. The effectiveness of such an attack would be most noticeable in the case of a surprise attack, one with tactical warning only. In such a case, the Rail MX would probably have very low survivability even without an expanded Soviet force, since destroying the very lucrative 10-warhead targets would not require a very large expenditure of Soviet resources. SICBM survivability may be considerably degraded compared with the preceding analysis, although it would come at a considerable price to the Soviets in terms of warheads expended for the barrage attack. The United States could take steps to restore the survivability of SICBM by in-

creasing its peacetime dispersal area at bases in the Southwest, although it would be more costly to do so.12/

There would be a large imbalance in overall forces between the United States and the Soviet Union. By 1996, without any additional procurement by the United States beyond current plans, the Soviets could have about 8,000 more warheads, although the United States could have about 3,000 more hard-target capable warheads. With additional Soviet forces, however, the United States may have additional targeting requirements as well. Although by an important measure in terms of U.S. deterrent posture, the United States would continue to have large numbers of warheads able to survive a Soviet attack and retaliate, some analysts would argue that preserving a balance of forces is also a critical component of deterring war and preventing aggression by denying even the perception of superiority.

In summary, the survivability of U.S. forces would not be greatly affected by a Soviet expansion, and in most cases measures could be taken to preserve survivability in affected forces, though at a significant price. If U.S. policymakers decided that preserving a balance of forces in overall numbers was also necessary for deterrence, matching such an expansion could be very costly to the United States, although it would also presumably have been costly for the Soviet Union.

COST OF CONTINUING MODERNIZATION

While new systems could have a significant effect on the survivability and retaliatory capability of U.S. forces, they also command a high price. The Department of Defense estimates that, in its 1988 budget request, total obligational authority for strategic forces would amount to $39.2 billion, rising to $42.1 billion in 1989. This amount includes obligational authority for procurement of new weapons, modification and operation of existing weapons, and research on future weapons. By this definition, strategic forces would account for 12.9 percent of the total DoD budget request in 1988 and 13.4 percent in 1989.

12. See Congressional Budget Office, "Forgoing SALT: Potential Costs and Effects on Strategic Capabilities" (Staff Working Paper, August 1986), for analysis of a barrage attack on the SICBM, and costs of expanded SICBM basing.

Strategic costs could continue to grow in the years beyond 1989. The Department of Defense does not provide public estimates of costs attributable to strategic forces beyond the budget years of 1988 and 1989. Nor can numbers be projected accurately using DoD's definition of the strategic force budget, since projections for certain types of costs are not available beyond 1989--for example, those for research and procurement of minor systems, modifications of existing systems, and operating costs. Nonetheless, as Table 5 shows, research and procurement costs for selected major systems would continue to grow and, depending on what happens to other costs, could drive up total strategic costs. For major systems with publicly available cost estimates, research and procurement costs would grow modestly from $19.2 billion in 1988 to a peak of $22.9 billion in 1990 and then fall to $21.4 billion in 1992. But these costs exclude those for one of the largest programs--the Advanced Technology Bomber--whose costs are classified but likely to be growing sharply. Beyond 1992, costs could decrease as systems now planned for research and procurement are completed. That decrease might not occur, however, if, for example, the United States decided to deploy some version of a strategic defense. According to the Director of the Strategic Defense Initiative Organization, Lt. General James Abrahamson, estimates of the total costs related to an initial deployment of even a limited system range from $70 billion to $100 billion.

EFFECTS OF RECENT ARMS CONTROL PROPOSALS

Verifiable agreements limiting strategic weapons could offer important advantages to the United States; the benefits and risks of such agreements are not the focus of this analysis. It seems unlikely, however, that arms agreements currently being discussed will greatly reduce the costs of strategic forces. During arms negotiations, the Administration has consistently proposed deep reductions in the size of U.S. and Soviet nuclear arsenals. This section briefly examines the possible cost effects of some of the Administration's proposals made at the summit in Reykjavik, Iceland, in October 1986.

TABLE 5. MAJOR STRATEGIC INVESTMENT: 1987-1992
(In billions of current dollars of budget authority)

	1987	1988	1989	1990	1991	1992	Five-Year Costs 1988-1992
Major Procurement							
MX Missile							
Quantity	12	21	21	21	21	21	105
Cost	1.1	1.3	1.4	1.2	1.1	1.0	6.0
MX Rail Basing							
Quantity	0	0	0	5	25	20	50
Cost	0	0	0	1.2	2.2	1.5	4.9
SICBM							
Quantity	0	0	0	18	36	60	114
Cost	0	0	0.1	3.1	2.9	3.6	9.7
Trident SSBN							
Quantity	1	1	1	1	1	1	5
Cost	1.4	1.4	1.4	1.5	1.6	1.6	7.5
Trident II (D-5)							
Quantity	21	66	66	66	72	72	342
Cost	1.3	2.3	2.2	2.2	2.1	2.0	10.8
SRAM II							
Quantity	0	0	0	0	25	75	100
Cost	0	0	0	a/	0.2	0.2	0.4
KC-135R							
Quantity	50	36	36	36	36	36	180
Cost	0.8	0.6	0.6	0.7	0.7	0.7	3.3
E-6A							
Quantity	3	3	7	0	0	0	10
Cost	0.4	0.4	0.4	0	0	0	0.8
Other Major Programs							
Cost	2.1	1.8	2.3	2.3	1.5	1.3	9.2
B-52/B-1B							
Cost	0.5	0.3	0.3	n.a.	n.a.	n.a.	0.6
ATB							
Cost	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Subtotal for Major Procurement							
In current year dollars	7.7	8.1	8.7	12.2	12.3	11.9	53.2
In 1988 dollars	7.9	8.1	8.4	11.5	11.4	10.7	50.2

(Continued)

TABLE 5. (Continued)

	1987	1988	1989	1990	1991	1992	Five-Year Costs 1988-1992
Major RDT&E							
SDI							
Cost	3.2	5.2	6.3	7.4	8.4	9.8	37.1
Rail MX							
Cost	a/	0.6	1.2	0.8	0.6	a/	3.2
SICBM							
Cost	1.1	2.2	2.2	2.1	1.4	0.8	8.7
Trident II (D-5)							
Cost	1.6	1.1	0.5	0.3	0.2	0.1	2.2
SRAM II							
Cost	a/	0.2	0.2	0.3	0.1	a/	0.8
Other Major Programs b/							
Cost	1.1	1.4	1.2	1.2	1.2	1.2	6.2
B-52/B-1B							
Cost	0.1	0.4	0.4	n.a.	n.a.	n.a.	0.8
ATB							
Cost	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Subtotal for Major RDT&E							
In current year dollars	7.2	11.1	12.0	12.1	11.9	11.9	59.0
In 1988 dollars	7.4	11.1	11.6	11.4	10.9	10.7	55.6
Total Investment (In 1988 dollars)	15.4	19.2	20.1	22.9	22.2	21.4	105.8
Real Growth (In percents)	---	25	5	14	-3	-4	---

SOURCE: Congressional Budget Office based on Department of Defense data.

NOTES: Details may not add to totals because of rounding.
n.a. = not available.

a. Less than $100 million.
b. Detail available through 1989. Estimates assume 1989 costs will continue beyond 1989.

Possible Agreement

According to Administration testimony, the Reykjavik summit produced one area of agreement (in principle) regarding offensive forces, an agreement calling for reductions of 50 percent in strategic force levels.13/ More specifically, the agreement called for reductions over a five-year period to a ceiling of:

- 1,600 strategic nuclear delivery vehicles (SNDVs), consisting of sea-based and land-based intercontinental ballistic missiles and heavy bombers; and
- 6,000 warheads carried by those SNDVs.

Negotiators also agreed to a special, important counting rule for warheads carried by strategic bombers. For bombers carrying cruise missiles, each cruise missile would count individually as one warhead. But for bombers carrying short-range weapons, each bomber load would count as only one warhead, regardless of the actual number of bombs or short-range attack missiles carried.14/ Furthermore, both sides agreed to the right to pursue more restrictive sublimits, such as those on heavy ICBMs, and to address separately the issue of limits on sea-launched cruise missiles.

While the United States and the Soviet Union agreed in principle on general limits on strategic offensive forces, there are still many areas--such as sublimits to configure forces--requiring resolution. Also, the Soviets insisted that offensive limits be accompanied by limits on the U.S. Strategic Defense Initiative. Such limits were not acceptable to the United States. Thus, the Reykjavik summit produced

13. Testimony of Richard Perle, Assistant Secretary of Defense for International Security Policy, and others, before the Defense Policy Panel of the Committee on Armed Services, House of Representatives, November/December 1986 (Committee print number 99-48).

14. According to Mr. Perle's testimony, the United States insisted on the counting rule for penetrating bombers--those carrying short-range weapons--since they would have to penetrate heavily concentrated Soviet air defenses to accomplish their mission. Because many of these bombers might be lost, the United States felt all these weapons should not count. The Soviets are reportedly more concerned about U.S. cruise missiles and so may have considered the two rules a good compromise.

no formal agreement limiting either offensive or defensive weapons. Nonetheless, this section analyzes the above proposed framework for offensive limits, since the framework will probably form the basis for any future accord.

Effect on the Administration's Plan

Most of the Administration's modernization program could be accommodated within the general offensive force limits considered at Reykjavik, but the accommodation would require earlier and more extensive retirement of existing forces than is currently planned. There are two exceptions, however. One pertains to the plans to have bombers carry cruise missiles, which would probably have to be severely curtailed to avoid drastic reductions in other modernization programs. Most of these cruise missiles have already been procured but need not be deployed. The second exception pertains to the number of warheads tested on the new Trident II missile. The Navy reportedly plans to carry a mix of smaller Mark 4 and larger Mark 5 warheads on the missile. The missile can reportedly carry twelve Mark 4 warheads, or eight Mark 5 warheads.15/ To accomplish the modernization program as planned, the maximum number of warheads the Trident II can be counted as having is eight.16/

With these constraints, the United States could accommodate its modernization program within the Reykjavik limits with the retirement of systems listed in Table 6. This "fully modernized" approach does not significantly alter new procurements.17/ However,

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15. See Michael Gordon, "U.S. Plans to Test Submarine Missile with Twelve Warheads," *New York Times*, October 7, 1987, p. 1.

16. For reasons of verification, under the precedent of SALT-type counting rules, a missile is always counted as having the maximum number of warheads with which it has been tested. The missile has been tested with more than eight warheads. While other counting rules may be agreed upon, if, in the final arms control agreement, the D-5 is credited with more than eight warheads, it will probably significantly reduce the number of Trident submarines (or other ballistic missile weapons) allowed to be deployed, since each Trident submarine carries 24 missiles.

17. The sublimits proposed by the United States would have a somewhat greater effect on procurement plans. These proposed sublimits are reportedly the following:

(Continued)

TABLE 6. CHANGES IN U.S. PLANS UNDER ILLUSTRATIVE, "FULLY MODERNIZED" APPROACH

Systems Retired Early

All Minuteman III missiles
294 Minuteman II missiles
242 B-52 bombers a/
All Poseidon submarines

Changes in Procurement

Fewer Advanced Cruise Missiles (Details classified)

Resulting Forces in Year 2000 b/

156 Minuteman II missiles
50 silo-based MX missiles
50 rail-based MX missiles
500 SICBMs

20 Trident SSBNs with Trident II missiles

21 B-52H bombers with ALCMs carried externally c/
100 B-1B bombers
132 ATB bombers

SOURCE: Congressional Budget Office estimates.

a. If the United States were allowed to retain 69 B-52Gs dedicated to the conventional mission, then only 194 B-52Gs would retire early.

b. The year 2000 was chosen for illustration to capture the full effects of the modernization program. Early retirements, however, assume the agreement is actually implemented in 1988 and that the five-year timetable for reductions pertains.

c. B-52s can carry 12 ALCMs externally. B-52Hs are currently planned to be further modified to carry eight ALCMs internally, beginning in the late-1980s. This illustration assumes that internal modifications are not done on the remaining B-52s.

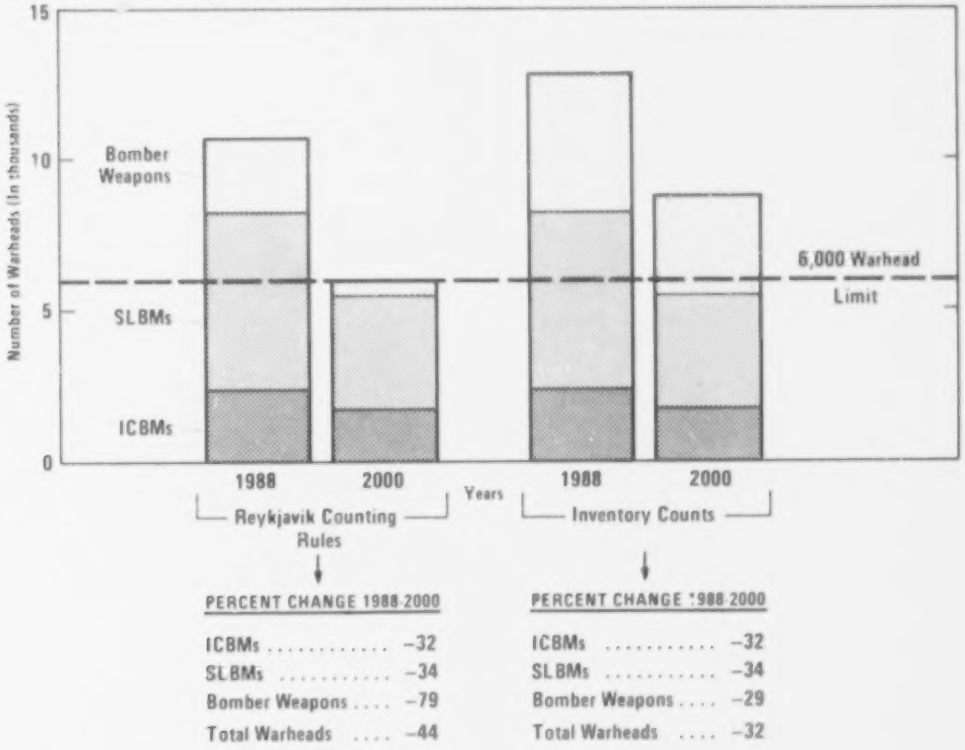
17. (Continued)

- o 1,650 total warheads on heavy ICBMs, medium ICBMs carrying more than six warheads apiece, and mobile ICBMs (if permitted at all);
- o 3,300 total ICBM warheads; and
- o 4,800 total ballistic missile warheads.

Compared with the force structure in Table 6, these sublimits would require retiring the remaining Minuteman II ICBMs; deploying a total of 17 Trident submarines; and retaining 77 B-52Hs with externally carried cruise missiles; or 47 B-52Hs with both internally and externally carried cruise missiles.

the United States would have to retire all of its Minuteman III and most of its Minuteman II missiles, as well as most of its B-52 bombers and all of its Poseidon submarines. Furthermore, under this approach, one squadron of B-52s would carry cruise missiles, but no B-1B bombers would do so. Under current plans, all B-52s assigned to the strategic mission and all B-1Bs would eventually carry cruise missiles. Most of these missiles have already been bought but would not be deployed. Under Reykjavik counting rules, this fully modernized approach would reduce total U.S. warheads by 44 percent below what they would have been under the Administration's plan (see Figure 7). Under the Reykjavik rules, reductions would be heaviest in bomber weapons and smaller in ICBMs and SLBMs.

Figure 7.
Illustrative U.S. Force Under Reykjavik Proposal (With modernization)



SOURCE: Congressional Budget Office estimates.

Compared with reductions under the Reykjavik counting rules, reductions in actual inventories would be smaller--only 32 percent--coming down to a level of about 8,700 warheads rather than a 44 percent reduction to 6,000 warheads. Actual inventory reductions are smaller because, under the fully modernized approach, the United States could keep a number of bombers armed with short-range attack missiles and bombs. These bombers would count as one warhead under the Reykjavik rules but would actually carry many weapons. For example, the B-1B could carry 8 bombs and 16 SRAM IIs in a penetrating role.

Assuming these U.S. reductions began in 1988 and followed the fully modernized approach described above, the cost savings would come mostly from retiring weapons sytems and resulting reductions in operating and support costs. Eventually, these savings could average $2 billion a year. Cost savings in early years, however, could be offset by one-time costs of retiring U.S. forces. Another potentially costly item could be future upgrades to the B-1B force to maintain its capabilities for penetration to the year 2000. (The B-1B is planned to retain a shoot-penetrate role in the Administration baseline; however, a pure penetration role may be more demanding.) Savings could be substantially larger if the United States responded to the Reykjavik limits by curtailing modernization rather than by accelerating retirements of existing systems. Regardless of the U.S. approach, however, very long-run savings could be substantial since there would be fewer systems to replace.

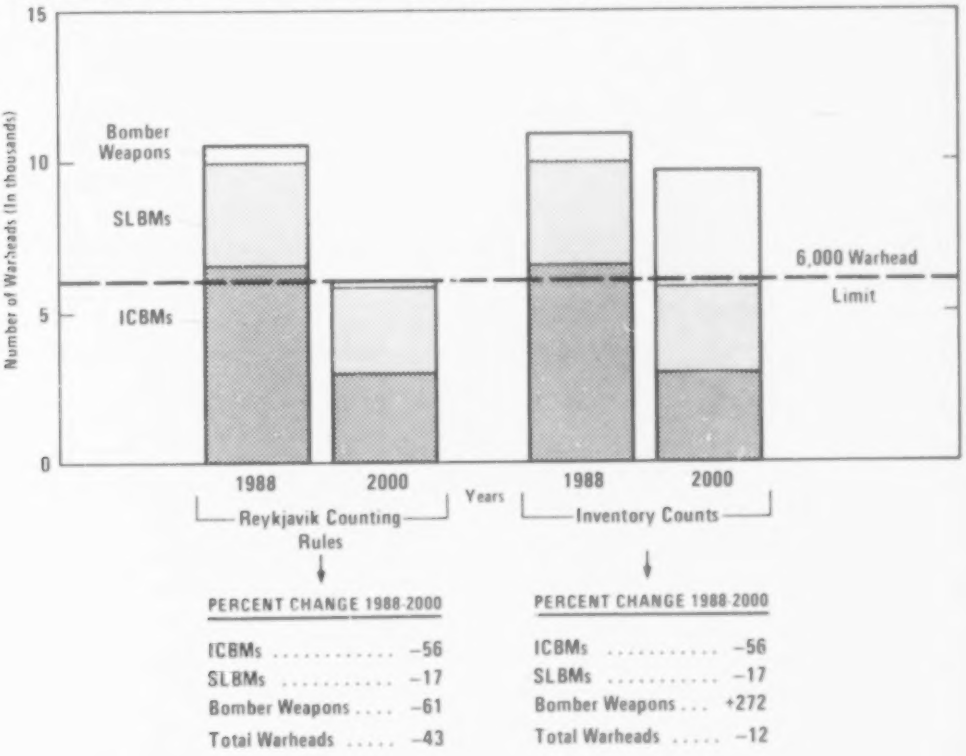
The Reykjavik proposal would probably have a greater effect on Soviet modernization plans than on U.S. plans (see Figure 8). In addition to modernizing their land-based missiles, which dominate their triad, the Soviets currently plan to replace most of their submarine-based missiles, many of which now have single warheads, with missiles that have multiple warheads. They also plan to add cruise missiles to their bomber force. These moves will sharply increase their total number of warheads. Under the Reykjavik agreements, the Soviets would have to modify their modernization plans or sharply reduce their land-based missiles.

Figure 8 shows the effects on Soviet forces if the Soviet Union were to continue with their submarine modernization plans and offset with reductions in land-based missiles. Figure 8 also assumes that the

Soviets would modernize, but not greatly expand, their bomber force. Under these assumptions, percentage reductions in total Soviet warheads are less than U.S. reductions, but Soviet reductions fall much more heavily on their land- based missiles.

Both the United States and the Soviet Union would have strong incentives under the Reykjavik proposal to increase the numbers of bombers that do not carry cruise missiles. As noted above, such bombers count as only one warhead but actually carry many weapons.

Figure 8.
Illustrative Soviet Force Under Reykjavik Proposal (With modernization)



SOURCE: Congressional Budget Office estimates.

This incentive could be the greatest for the Soviet Union, since it traditionally has had a much smaller bomber force than the United States. It could have a costly effect on the United States, however, since the United States has not invested as heavily in air defenses against bomber attacks as has the Soviet Union. An emphasis on bombers, however, is considered by many analysts to be more stabilizing than one on ballistic missiles. Since bombers take many hours to reach their targets--barring fundamental changes in technology--the potential for their use in an effective surprise or "bolt-out-of-the-blue" attack is greatly minimized.

Effects of More Far-Reaching Limits

The final U.S. proposal at Reykjavik also contained more far-reaching reductions. It proposed that both sides eliminate all offensive ballistic missiles (ICBMs and SLBMs) over a second five-year period following the achievement of the limits discussed above. During the 10-year period of offensive force reductions, both sides would also agree to abide by the terms of the Anti-Ballistic Missile (ABM) treaty. At the conclusion of the 10 years, however, each side would be free to deploy strategic defenses unless otherwise agreed. The analogous Soviet proposal reportedly called for eliminating all strategic weapons, not just ballistic missiles, and for placing restrictions on strategic defense research beyond that in the ABM treaty.

Clearly, either proposal in its entirety would have significant effects on current plans to modernize. Under the U.S. version, all ballistic missiles--including MX, SICBM, and Trident II--would be banned by the end of the 10-year period of reductions. Since most of the new U.S. systems would not even begin to be deployed for five or more years, it would make little sense to pursue them. This study does not analyze these far-reaching proposals more fully, however, since they seem much less likely to be included in future arms agreements than the more modest limits discussed above.

Without agreement on these far-reaching arms limits, Administration plans for rising strategic costs would most likely not be altered significantly by arms control. Coupled with the limits the Congress seems likely to impose on total defense spending, rising strategic costs raise a question. Can the United States still achieve

effective deterrence of nuclear war if it buys and operates fewer strategic systems than under Administration plans? Unfortunately, there can be no clear answer to that question, since deterrence depends on perceptions and judgments that cannot be quantified. Nonetheless, the trends in strategic forces discussed earlier--coupled with specifics of forces planned for deployments--suggest alternative approaches.

CHAPTER IV

ALTERNATIVES TO THE ADMINISTRATION'S MODERNIZATION PROGRAM

Some analysts have argued that the Administration's strategic buildup is too broad, that the United States is buying excessive capability. These arguments reflect several conclusions and concerns. One main concern is over the ramifications, discussed earlier, of emphasizing the targeting of military forces, communications, and leadership facilities. This concern has focused most strongly on Administration plans to add an abundance of hard-target capability. Another concern is that farther-reaching Administration goals both for arms control--such as sublimits on missile warheads--and for a ban on mobile missiles require deep reductions in offensive force levels that may be inconsistent with such an extensive buildup. An effective strategic defense may also be inconsistent with a mutual buildup of offensive forces.1/

The cost of the buildup is also a major concern. According to the Administration's budget plan, the share of the defense budget allocated to strategic forces would grow from about 11.9 percent in 1987 to about 13.4 percent in 1989. Growth would probably continue through 1992, although the Secretary of Defense has stated that the share of the budget would not exceed 15 percent in any year. Some Members of the Congress express concern that increasing funds for strategic forces takes away from funds needed to improve conventional capabilities. This concern may be especially valid if the Congress limits growth in overall spending for defense or actually reduces it.

1. According to Secretary of Defense Weinberger, current plans for SDI involve phased deployments beginning in 1994 or 1995. Some analysts believe that such plans make less sense with large amounts of offensive capability and that offensive force reductions should precede SDI. Others believe that deployed defenses will be the vehicle by which offensive forces will be reduced.

In light of these concerns, this chapter considers four alternatives to the Administration's plan that would reduce costs. It also examines the effects of these alternatives on the three main goals of the modernization program. All of the options assume the triad would be continued, since it has been a long-standing and, most observers believe, useful feature of the U.S. force posture. Some have advocated a fundamental change in this posture, such as moving toward a dyad of sea-based and air-based forces, or even solely relying on the submarine force. Since these changes would retain only a portion of the current force, they would certainly be less expensive in terms of simple expenditures. On the other hand, the overwhelming majority of policymakers have consistently decided that the diversity and security inherent in a triad of survivable forces enhances deterrence in ways that make it worthwhile.

ALTERNATIVE I: DO NOT BACKFIT TRIDENT SUBMARINES

The United States is currently procuring Trident submarines. Fourteen have already been funded, with plans to continue buying the submarines at the rate of one per year until about 20 have been bought. These submarines are designed to carry the large and accurate Trident II missiles, the first of which were authorized and appropriated in 1987.

Because Trident II missiles were not available when the submarines were deployed, the first eight of them were equipped with the smaller and less accurate Trident I missiles. Beginning in the early 1990s, the Administration plans to modify these submarines, remove the Trident I missiles, and replace them ("backfit" them) with the new Trident II missile.

One alternative for reducing costs would be to eliminate the modification and backfit of the eight Trident submarines with Trident II missiles. Under this option, only the last 12 of the 20 Trident

submarines would be deployed with Trident II missiles, thereby reducing Trident II procurement from 844 missiles to 660.2/

To support the extended deployment of the Trident I missile, its flight- test program would be continued until the year 2012. Although that extended test program would require 146 Trident I missiles, no additional Trident I missiles would have to be procured; rather, the increased demand would be met by Trident I missiles currently in the stockpile or deployed aboard Poseidon submarines scheduled for retirement. In all other respects, this alternative is identical to the Administration's plan.

Although the first backfit of a Trident submarine with Trident II missiles is not scheduled until 1991, the Congress could indicate its intention to pursue this option by deleting $14.9 million in fiscal year 1988 budget authority, which is designated to provide advance planning and to begin procurement of long-lead items for converting the eight submarines.

Effects on the Administration's Modernization Goals

This alternative could adversely affect one of the Administration's modernization goals--namely, increasing U.S. hard-target retaliatory capability--though substantial capability would remain. The actual effect would depend on the mix of Mark 5 and Mark 4 warheads the Navy plans to have on the Trident II missiles.3/ Only if the planned ratio of Mark 5 to Mark 4 warheads were greater than 60 to 40, would there be any reduction of hard-target warheads at all under this

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2. In some years, a maximum of 12 submarines would be deployed with Trident II missiles rather than 19 submarines as under the Administration's plan (of the 20 Trident submarines, one would always be undergoing an overhaul). As a result, seven fewer shiploads of missiles would have to be procured. In addition, the Demonstration and Shakedown Operations (DASO) program would be reduced by 16 missiles. Trident II procurement, therefore, would be reduced by 184 missiles ((7 x 24) + 16 = 184 missiles). The current Administration's plan, which only extends through 1992, includes 19 submarines and 815 missiles. Based on Navy data and testimony cited earlier, this analysis assumes that the inventory objective is 20 submarines and 844 missiles.

3. The Navy reportedly plans a mix of Mark 4 and Mark 5 warheads on Trident II missiles, but has not publicly revealed details of the plans.

alternative. Tables 7 and 8 illustrate an upper bound for possible reductions in this measure, comparing the alternative to a baseline in which all Trident II missiles carry the Mark 5 warhead. Table 7 indicates the reductions in inventory counts of hard-target warheads--a reduction of 1,536 warheads, or about 12 percent.4/

Among the alternatives in this study, this alternative represents the largest decrease in numbers of hard-target capable warheads, compared with a Trident force of all Mark 5 warheads. However, it is very likely that, compared with actual Navy plans for a mix of Mark 4 and Mark 5 warheads, there would not be any reduction of hard-target capability under this alternative. Table 8 indicates the reductions in warheads surviving a Soviet attack and available for retaliation in a case with strategic warning and with tactical warning.

In the most likely case of a Soviet attack with strategic warning, this option would represent a decrease of almost 30 percent in surviving hard-target warheads available for prompt retaliation. In a surprise attack, the reduction would be about 23 percent. The United States would still, however, have about 3,000 warheads available for prompt retaliation in the first case and about 900 in the second case. One could argue that even this level of capability surpasses what the United States would need to deter a Soviet counterforce attack, and that eliminating "excess" HTK-capable warheads could increase rather than decrease stability, since the Soviets may view them as weapons the United States intends to use in a first strike.5/

Furthermore, again depending on the mix of Mark 5 and Mark 4 warheads on the Trident II missile, the total number of SLBM warheads could increase under this alternative, providing increased capability against the "softer" set of targets. Finally, the United

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4. In contrast to previous chapters, this chapter focuses on warhead changes in the year 2000 when all U.S. procurements have entered the inventory. Earlier chapters focused on U.S.-Soviet comparisons, and Soviet estimates available to CBO do not include projections beyond the mid-1990s.

5. For an extensive discussion of hard-target capability, see Congressional Budget Office, *Trident II Missiles: Capability, Costs, and Alternatives* (July 1986).

TABLE 7. COSTS AND EFFECTS OF ADMINISTRATION'S STRATEGIC PLAN AND ALTERNATIVE APPROACHES

	Investment Costs (In billions of 1988 budget authority dollars)				Hard-Target Warheads in Year 2000 a/
	Budget Costs		1988-1992	Total	
	1988	1989			
Administration's Plan	29.1	31.8	n.a.	n.a.	12,530
Savings/Changes Under:					
Alternative I: Do Not Backfit Trident Submarines	b/	0.2	0.8	5.8	-1,536 c/
Alternative II: Limit Further Land-Based Modernization					
No SICBM d/	2.2	2.3	18.0	37.4	-500
No Rail MX e/	0.6	1.2	8.4	8.4	-500
Alternative III: Cancel Manned Penetrating Bomber	n.a.	n.a.	n.a.	Over 40	+495
Alternative IV: Delay Further Modernization (Including ATB, SICBM, Rail MX, SRAM II) f/	1.7	2.4	17.9	n.a.	-424

SOURCE: Congressional Budget Office computations based on budget data.

NOTE: n.a. = not available.

a. These numbers represent inventory counts of ballistic missiles plus bomber weapons.

b. Less than $20 million.

c. This number represents the upper bound of possible reductions in hard-target warheads under this option since it is compared with a baseline in which all Trident II missiles carry the Mark 5 warhead.

d. The SICBM Selected Acquisition Report (SAR) does not include $1.6 billion (in current dollars) of projected savings in research and development costs. The Air Force has also identified significant production cost savings. These savings are currently being coordinated with the Office of the Secretary of Defense.

e. The MX Rail Garrison SAR excludes cost of production missiles, operational test and evaluation missiles, and initial spares for the Rail Garrison Basing Mode.

f. Savings from delaying the ATB are not available and are therefore not included.

TABLE 8. ILLUSTRATIVE EFFECTS OF ALTERNATIVES ON WARHEADS AVAILABLE FOR RETALIATION IN THE YEAR 2000

	U.S. Retaliatory Warheads Surviving a Soviet Attack					
	With Strategic Warning			With Tactical Warning		
	Total	Hard-Target Capable	Prompt Hard-Target Capable	Total	Hard-Target Capable	Prompt Hard-Target Capable
Administration's Plan	9,499	9,369	4,266	4,264	4,134	1,151
Changes Under:						
Alternative I: Do Not Backfit Trident Submarines a/	0	-1,209	-1,209	0	-798	-263
Alternative II: Limit Further Land-Based Modernization						
No SICBM	-405	-405	-405	-243	-243	-243
No Rail MX	-405	-405	-405	-20	-20	-20
Alternative III: Cancel Manned Penetrating Bomber	+432	+432	0	+130	+130	0
Alternative IV: Delay Further Modernization	-343	-343	-94	-131	-131	-56

SOURCE: Congressional Budget Office calculations.

NOTE: These figures represent on-line weapons counts. Counts are further adjusted for availability and assume that the United States absorbs a Soviet attack before retaliating. (This illustration uses attacking Soviet forces for 1996, because longer-range projections are not available.) In the case of tactical warning, they assume the SICBM retains 60 percent survivability which, unless the Soviets greatly expand their forces, is probably a lower bound if they choose to conduct a barrage attack. Only 5 percent of Rail MX is assumed to survive in a case with tactical warning because of the relatively small price to the Soviets to attack the system. In no case are airborne bombers assumed to be barraged because of the extremely adverse price to attack, and the fact they would still have to face heavy Soviet air defenses on their retaliatory mission. Furthermore, Soviet practice has reportedly been to keep their newer submarines closer to their own territory, which would lessen the threat of a barrage attack over time. All SLBMs at sea are considered prompt in the case of strategic warning; one-third of those at sea are counted as prompt in a case with tactical warning.

a. These numbers represent the upper bound of possible reductions in hard-target warheads under this option, since they are compared with a baseline in which all Trident II missiles carry the Mark 5 warhead.

States would also have a significant number of HTK-capable warheads on bombers that would be available for retaliation, though not promptly.

Other Effects

This option could lead to a trade-off between the optimal allocation of soft- and hard-target capable warheads in the Atlantic and Pacific Oceans, and optimal logistics. Only one of two Trident bases is currently equipped to handle the Trident I missile. If a mix of submarines with Trident I and Trident II missiles were desired at each base, additional equipment would be required. Basing all Trident I submarines in the Pacific and all Trident II submarines in the Atlantic may cause a less than optimal allocation against targets in the Soviet Union.

Savings

Savings would be relatively modest under this alternative. Costs would eventually be reduced by $5.8 billion (see Table 7). These savings reflect procurement of 184 fewer Trident II missiles and cancellation of plans to modify the first eight Trident submarines to carry the Trident II missiles. As was noted above, savings from buying fewer Trident II missiles need not be offset by the cost of buying more Trident I missiles. Only about $0.8 billion would be saved over the next five years and only about $0.2 billion in 1988 and 1989, the current years of the proposed two-year budget.

This option could also alter operating and support costs over the next decade. When it is fully carried out in about 10 years, the option should not affect operating costs significantly since the number of submarines would not be changed, just the number with Trident II missiles. During implementation, however, in the absence of the backfit program, more Trident submarines would be available for operation. If the Navy chose to operate them, that choice plus the additional costs of the extended Trident I flight-test program could add $0.9 billion to operating costs over the next 10 years when the backfits are under way. These added costs would offset investment savings noted above, making the effects of this option even more modest.

Thus, this option would be consistent with the assumption that the United States could maintain substantial strategic deterrence even with a potential reduction in the growth of hard-target warheads. Cost savings, however, would be modest. If the Congress wants significant cost reductions in the strategic buildup, it will have to consider more far-reaching changes.

ALTERNATIVE II: LIMIT FURTHER LAND-BASED MODERNIZATION

Today's silo-based ICBM force is widely considered vulnerable to a Soviet attack. The Administration's plans for shoring up the land-based leg of the triad include deploying about 500 small single-warhead missiles (SICBMs) in mobile launchers plus 50 of the 10-warhead MX missiles on rail cars.

Procuring both systems would cost a total of about $46 billion, and 15-year life-cycle costs would total about $58 billion. Quite conceivably, budgetary pressures will lead the Congress to consider choosing between the two systems, and indeed they have been increasingly treated as close substitutes.6/ They differ, however, in a number of ways, some of them potentially important to the Administration's modernization goals. For that reason, this alternative first examines the implications of a choice between the two programs and then assesses effects on modernization and costs.

Description of the Systems

Before one can examine the advantages and disadvantages of the two systems, it is important to understand how each system works. The SICBM would be a single-warhead missile deployed in a specially designed launch vehicle that is hardened to withstand a nuclear blast.7/ The MX is the same 10-warhead missile currently being de-

6. Both Senator Nunn and Senator Stennis remarked in recent testimony to General Chain, the Commander-in-Chief of the Strategic Air Command, that a choice will have to be made between the two systems because of fiscal constraints.

7. The Hard Mobile Launcher (HML) is widely reported to be hardened to withstand overpressures, on average, of 30 pounds per square inch.

ployed in existing silos, but the MX would be deployed aboard special railroad cars. Unlike the SICBM launcher, these railroad cars would not be designed to withstand a nuclear explosion.

Both systems would be mobile--that is, they are designed to move over large areas in order to make it difficult to destroy them with a nuclear attack. Indeed, with current technology, the only way to destroy them with a high degree of certainty would be to attack or "barrage" the entire area over which they are expected to be dispersed.

Although both systems are mobile, in peacetime they would be maintained in essentially fixed sites on military bases in order to minimize operating costs and avoid environmental problems. SICBMs are to be located at three Minuteman missile bases in the north-central United States.8/ The Rail MX missiles will be garrisoned at seven Air Force bases; the main operating base will be F.E. Warren Air Force Base, Wyoming. While in garrison, only a few of the missiles would be likely to survive a Soviet attack since their locations would be known. SICBM missiles can disperse randomly; Rail MX missiles have to travel along established rail lines. SICBM could be dispersed over more than 20,000 square miles within the 30 or so minutes of notice that a Soviet attack was under way. In contrast, MX missiles would require about six hours of advance warning to be dispersed sufficiently to achieve that same initial level of survivability (see Figure 9).9/

Advantages and Disadvantages of the Two Systems

The different designs of the two systems lead to varying advantages and disadvantages for each one. Thus, if the Congress decides to terminate one of these systems, it will not be an easy choice.

A fundamental difference between the two systems relates to the necessary warning conditions for their survivability. SICBM is

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8. These bases are Malmstrom AFB, Montana; F.E. Warren AFB, Wyoming; and Ellsworth AFB, South Dakota.

9. Information is based on preliminary estimates by the Department of Defense.

designed to achieve high levels of survivability in the 30 or so minutes of tactical warning that a Soviet attack was actually under way. Figure 10 illustrates the number of Soviet SS-18 equivalent warheads required to destroy 50 percent and 90 percent of the SICBM force in its tactical warning dispersal area. The examples illustrate the enormous price to the Soviets of attacking the system. (For perspective, the entire Soviet ICBM and SLBM force during the time period of this analysis is expected to have between 700 and 800 SS-18 throwweight equivalent missiles). The SICBM system also has inherent flexibility to respond to a greatly increased Soviet threat by expanding its peacetime dispersal area, although at greater cost. For instance, an earlier plan had SICBMs on bases in the southwest where they would be randomly dispersed over about 4,000 square miles in peacetime. (The expanded dispersal area in Figure 10 assumes half the force is based at the Minuteman sites, and half at the southwest bases.)

A Soviet attack with tactical warning is usually described as a "bolt-out-of-the-blue" attack; described as such, it is considered a highly unlikely occurrence. However, a so-called surprise attack can also occur even if, in retrospect, there were strategic warning indicators. History is rife with examples of strategic warning indicators being misinterpreted, of policymakers being reluctant to act upon them, or of their being truncated somewhere in the chain of command.10/

Rail MX is designed to achieve high levels of survivability in an attack with strategic warning which, even allowing for the above possibility, is still widely considered to be the more likely case. Its survivability would depend on dispersal well in advance of warning of an actual attack, and it would be dispersed on the public rail network. Depending on the situation, this decision might be difficult--for instance, if an Administration did not want to alarm or involve the public at a particular time.11/ Its survivability is likely to be very low

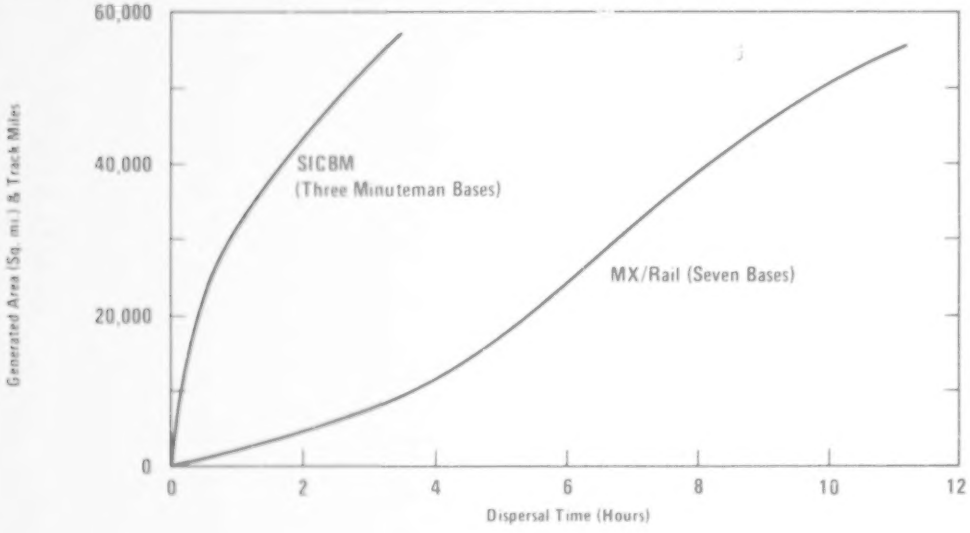
10. See Richard K. Betts, *Surprise Attack: Lessons for Defense Planning* (Washington, D.C.: The Brookings Institution, 1982).

11. Concern has also been expressed that early dispersal of MX over rail lines could interfere wtih other important activities on the rails such as transporting other war materiel. The Air Force indicates that the missile trains would account for such a small percentage of even normal activity on the rails--over 8,000 train start-ups a day--that they would not interfere. Furthermore, the missile trains would only be moving periodically to avoid being directly targeted.

if not dispersed well in advance of tactical warning, both because its dispersal area would be limited and because its 10 warheads per missile would be a lucrative target. To destroy 90 percent of Rail MX warheads in this case would require only 60 to 70 ICBMs of the SS-18 type.

What is the warning situation with respect to other legs of the triad? Significant costs are incurred in maintaining about 30 percent of the bomber force on constant alert in peacetime, so that those bombers may survive with tactical warning. Bombers not on alert would require strategic warning to survive. The survivability of the submarine force at sea is essentially independent of either tactical or strategic warning; the submarine force also incurs very high operation and support costs.

Figure 9.
Comparison of the Capability of the MX/Rail and Small ICBM

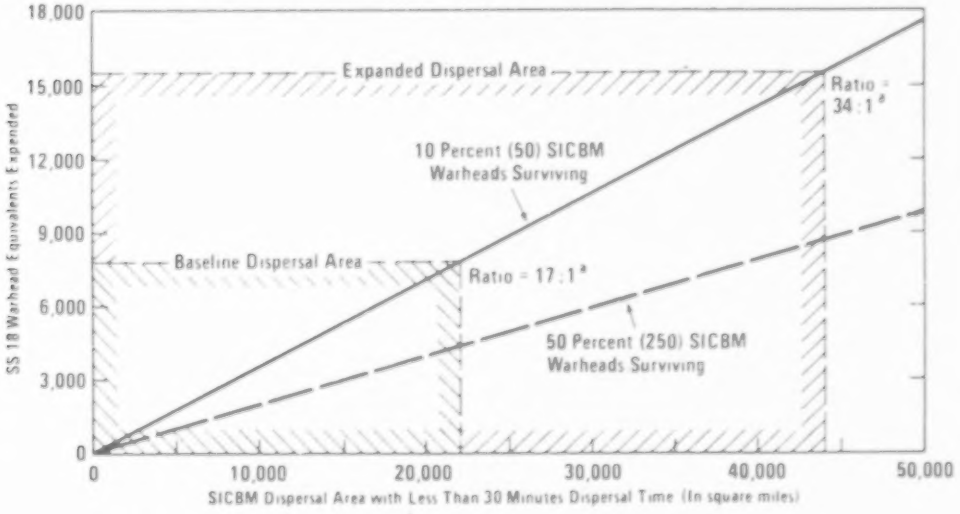


SOURCE: Congressional Budget Office based on preliminary estimates from Department of Defense.
NOTE: The dispersal capability of the SICBM is measured in square miles; that of the MX/Rail is measured in track miles.

Drawing conclusions about the appropriate warning sensitivity for the ICBM force from this picture is difficult. On the one hand, achieving some level of independence from strategic warning is obviously considered important and worth substantial cost. On the other hand, two legs of the triad have already achieved this independence, and the requirement for the ICBM force to also have this ability may be limited.

In addition to its advantages in a surprise attack, SICBM may meet other requirements that the MX does not. The Air Force has stated that it has a requirement for single-warhead missiles in the ICBM force for flexibility in targeting and presumably controlling escalation. Minuteman II missiles are currently the only ones available and, like the other silo-based missiles, are not considered likely to survive a direct Soviet attack. Moreover, at some point these

Figure 10.
Soviet Warheads Needed to Destroy 50 Percent and 90 Percent of U.S. Baseline SICBM Force, As a Function of Dispersal Area



SOURCE: Congressional Budget Office.

a. Ratio of Soviet attacking warheads to U.S. SICBMs destroyed.

older Minuteman II missiles would have to be replaced with new missiles. Without SICBM, yet another missile may have to be developed. Finally, SICBM's launcher vehicle, which is hardened and off-road mobile, is more likely to survive during an extended conflict.

Cost and Cost-Effectiveness

Rail MX is clearly much cheaper than SICBM. To deploy 500 missiles, investment costs for MX are about 20 percent of those for SICBM--$8.4 billion for the MX compared with $37.4 billion for SICBM. Annual operating and support costs for the MX are also about 40 percent of those for SICBM--about $230 million compared with about $580 million. Thus, total costs to deploy and operate the system for 15 years amount to about $12 billion for MX and about $46 billion for SICBM.

Because the MX is so much cheaper to buy and operate, it is much more cost-effective, assuming that both systems are fully dispersed and thus likely to survive an attack. In this case, measured in terms of a 15-year life-cycle cost per on-line surviving warhead, Rail MX costs only about $29.6 million per warhead compared with $113.6 million per SICBM warhead (see Table 8 for surviving warheads).

In the event of a surprise attack, however, SICBM would be the more cost-effective system. Assuming a probable lower bound for SICBM survivability of 60 percent--in terms of surviving warheads available for retaliation--Rail MX would cost about $600 million per warhead, while SICBM would cost about $189 million per warhead.

Effects on the Administration's Modernization Goals

A decision not to deploy either SICBM or Rail MX will have adverse effects on the buildup of U.S. warheads, though many warheads would still remain. For example, before any Soviet attack, either SICBM or the MX would provide 500 warheads. Since about 90 percent are expected to be on-line, terminating either system could reduce available hard-target weapons by about 450. Nonetheless, about 5,500 hard-target ballistic missile warheads would remain in the U.S. arsenal even without one or the other of these systems. More of these warheads, however, would be based on submarines, increasing the

risks involved in some failure of this system. The effects on U.S. capability after a Soviet attack depend on the assumptions that are used. The numbers of warheads that would be lost depend on assumptions regarding the scenario for attack and the degree of dispersal of each system.

Savings

Savings under this alternative depend on whether the Congress elects to terminate SICBM or rail MX. Terminating SICBM would save $18 billion in investment costs over the next five years, and by 1999 would save a total of $37.4 billion. Savings in 1988 would amount to $2.2 billion. Canceling SICBM would also eventually save about $580 million a year in operating costs (see Table 7).

Terminating the MX would reduce investment costs by $8.4 billion, with almost all savings occurring over the next five years. Savings in 1988 would equal $0.6 billion. Savings from operating costs would total about $230 million annually.

These savings are difficult to put into perspective because, as noted in Chapter III, total planned costs for strategic modernization under the Administration's plans are not available beyond 1989. Solely for the sake of illustrating the effects of this option, however, assume that strategic investment costs under the Administration's plans grow in real terms by an average of 5 percent a year in the 1988-1992 period, reflecting the large number of new systems entering procurement. With such growth, canceling SICBM represents a reduction in investment costs of about two percentage points in the annual growth rate. Canceling MX would have much more modest effects.

ALTERNATIVE III. CANCEL MANNED PENETRATING BOMBER

Terminating either the Rail MX or SICBM program--but especially the SICBM program--would substantially reduce costs. The Congress could also reduce costs markedly by forgoing a manned penetrating bomber. This option would cancel procurement of the Advanced

Technology--or "stealth"--Bomber (also known as the B-2) and would rely instead on the old B-52s and the new B-1Bs. To arm them fully would require additional procurement of about 1,200 advanced cruise missiles. Since the B-52Gs would be retained longer under this option than under the Administration's plan, additional modifications beyond those already planned might also be needed. These modifications would increase reliability, maintainability, and sustainability, and would add to costs. The B-1B would retain its shoot-then-penetrate role as in the Administration's plan.

Effects on the Administration's Modernization Goals

This option would show a modest increase in the numbers of warheads reflected in the quantitative measures of U.S. capability (see Tables 7 and 8). The United States would, however, forgo the advantages and flexibility of an advanced manned bomber better able to penetrate Soviet air defenses, which the Administration believes is important to deterrence. Thus, the Administration's third modernization goal would not be fully met.

How important is this goal? The main mission for a manned penetrating bomber is to detect and destroy mobile targets, and the number of mobile missiles and mobile command and control systems is likely to grow significantly in the Soviet Union. Proponents of a manned penetrating bomber believe that deterrence requires U.S. ability to put a significant portion of these targets at risk in the event of Soviet aggression.

Mobile systems, however, are generally thought to enhance stability and deterrence, since they significantly reduce the value of an attack and since they can provide some assured retaliatory capability. In a crisis, if neither nation felt it would lose its retaliatory capability to a preemptive attack by the opponent, the pressure to use these forces first would be reduced. The importance of survivable forces grows as both nations incorporate more accurate, prompt weapons in their arsenals.12/ Thus, opponents of this mission believe that it contradicts U.S. efforts to encourage both sides to deploy more

12. Survivability would also be of greater importance if force levels were greatly reduced under arms control.

survivable, stabilizing weapons systems, and that it may increase pressure for another round of the arms race if the Soviets seek ways to protect their mobile systems or to attack U.S. mobile systems. Furthermore, it is hard to evaluate how effective a manned bomber would actually be in search-and-destroy efforts occurring after a nuclear exchange.

Damage assessment--another mission for penetrating bombers--may also possibly be accomplished by satellites or very-high-altitude reconnaissance aircraft, although their ability to operate after a nuclear attack is also questionable. Nor would cancellation of the Advanced Technology Bomber inhibit use of stealth technology for conventional (non-nuclear) defenses. The United States plans to procure advanced fighters with stealth characteristics, thus allowing continued development of the technology for conventional missions.

Under this option, the overall effectiveness of the bomber force is likely to be reduced, since two penetrating bombers with different penetration characteristics as well as cruise missile carriers can stress Soviet air defenses and provide more extensive target coverage. However, in the alternative force, the B-1B would still penetrate and presumably could focus on a smaller set of high-priority targets, and the alternative force would have more cruise missile carriers.

Savings

Savings under this option cannot be assessed accurately, though they are likely to be substantial. The Advanced Technology Bomber program is a highly classified, "black" program; only the most aggregate information about costs and capability have been made public.

Nonetheless, this option would probably reduce costs sharply. Based on press reports of DoD statements, the total cost of developing and procuring the ATB would be about $57 billion. Although some of these funds have already been expended, most have probably not yet been spent since the ATB is not expected to have its initial operating capability until the early 1990s. There would, however, be some added costs under this option. For example, under this option an additional 1,200 advanced cruise missiles would have to be procured, another program for which costs are not publicly available.

When all the pluses and minuses are totaled, this option could probably reduce costs over the next decade by a total of $40 billion or more. A substantial amount of these savings would occur over the next five years and would markedly alter strategic costs.

Operating costs under this option could well increase, though again it is difficult to know by how much. Operating and support costs to maintain B-52G bombers in the force until the year 2000 would total nearly $10 billion. These added costs would be offset, because costs to operate and support a larger number of the ATBs would not be incurred under this option. Again, those costs are not publicly known.

ALTERNATIVE IV: DELAY FURTHER MODERNIZATION

The Congress may decide that it does not wish to eliminate a manned penetrating bomber or survivable land-based missiles but still must hold down costs. It could accomplish this by delaying procurement of new programs but not canceling them. Senator Sam Nunn, Chairman of the Senate Committee on Armed Services, has recommended this general approach--though not necessarily the specifics of this option.

This option would delay all major weapons programs in research and development for three years, maintaining R&D at 1987 funding levels in real terms but assuming no increase in total planned R&D expenditures. Programs delayed would include the ATB, the SICBM, Rail MX, and the SRAM II attack missile.

Effects on the Administration's Modernization Goals

This option would delay modernization and upgrading of the triad, the first of the Administration's three goals. The major systems affected by this option would probably not begin to be deployed until the mid-1990s whereas, under current plans, they would be largely deployed by this time. Also, this option would delay the goals of having a new manned penetrating bomber and survivable ICBMs.

Differences in warhead measures for this option compared with the Administration baseline tend to be modest throughout the 1990s, and are similar to the effects shown in Table 8 for the year 2000. However, as with the other options, there may be differences in less quantifiable measures of capability. Beyond the year 2000, differences resulting from this option would rapidly disappear as delayed systems become fully deployed.

Savings

Excluding savings from delaying the ATB, total five-year investment savings under this option would be $17.9 billion (see Table 7). Over the next two years alone, savings less those for the ATB would total $4.1 billion. Although this study cannot determine the savings from delaying the ATB because estimates are not available publicly, savings are likely to be substantial. The ATB is a $57 billion program that is probably approaching a period of heavy expenditure.

Even without savings from the ATB, these reductions could substantially alter the pace of strategic investment funding. If, for example, the Administration's plans result in 5 percent annual real growth over the next five years, this option would cut total costs by about 8 percent at a minimum, and leave growth averaging at most about 3 percent a year. Actual growth would be significantly lower because of savings from delaying the ATB.

The Congressional Budget Office cannot accurately determine the long-run effects of this option on investment costs, but there is a clear risk that they will increase. For example, delays would probably increase some development costs because contractors would keep their development teams together but could not proceed at full pace. On the other hand, delay could hold down some costs. General Skantze, recent head of the command that oversees development of all Air Force weapons, argues that the high level of concurrency (that is, overlapping development and production) in the B-1B program was a factor in the problems that the aircraft is now experiencing. Delays under this option would minimize concurrency.

This option should reduce near-term operating costs by modest amounts because of delayed deployments. In the long run, however, there should be little change in operating costs.

CONGRESSIONAL ACTION TO DATE

As this study goes to press, Congressional action is proceeding on the President's budget request for fiscal years 1988 and 1989. The House and Senate have completed action on a bill authorizing defense appropriations for 1988 and 1989, while the House Committee on Appropriations has issued a bill appropriating funds for 1988. Because budget actions are not completed, they are not reflected here; costs and savings in this study reflect the President's budget proposals.

Congressional action will certainly affect the detailed costs of options in this study. Beyond slowing the development of systems, however, actions to date include no major changes in plans for offensive strategic weapons. In fact, in the case of ICBM modernization, the authorization conferees explicitly decided to preserve both the SICBM and Rail MX programs as options for the next Administration. Thus, the issues discussed in this chapter are likely to be options in next year's debate. The table below shows Congressional action to date on selected major weapons systems.

	President's Budget Request	Authorization Conference		House Committee on Appropriations
		Low Tier a/	High Tier	
SICBM	2,233	700	1,500	1,575
Rail MX	591	100	300	250
Trident Submarine	1,194	1,154	1,154	1,124
Trident II Missile				
(Procurement)	1,931	1,931	1,931	1,462
(RDT&E)	1,099	1,049	1,074	1,000

SOURCE: Congressional Budget Office using budget data for fiscal year 1988.

a. The low tier applies if total appropriations for the national defense function (050) equal $289 billion of budget authority or less.

APPENDIXES

APPENDIX A

DESCRIPTION OF THE UNITED STATES TRIAD OF STRATEGIC OFFENSIVE FORCES

For more than two decades, U.S. nuclear forces have consisted of the triad of land-based intercontinental ballistic missiles (ICBMs), long-range bomber and tanker aircraft, and submarine-launched ballistic missiles (SLBMs) on strategic nuclear submarines (SSBNs). The individual components of the triad are described below.

THE ICBM FORCE

The ICBM force probably has the most complete set of desirable operational characteristics. These include accuracy, high alert rates, secure and reliable command and control, targeting flexibility, and ability to retaliate promptly with considerable likelihood of penetrating to a target. The most glaring weakness of silo-based ICBMs, which currently characterizes all U.S. ICBMs, is their vulnerability to a preemptive attack. They cannot be recalled once launched.

Minuteman II. The 450 single-warhead Minuteman IIs were deployed starting in 1965. Their warheads are relatively large but inaccurate.

Minuteman III. These ICBMs are equipped with three multiple independently targetable reentry vehicles (MIRVs). Of 550 Minuteman IIIs, 250 carry the Mk 12 warhead and 300 the higher-yield Mk 12A. All have been improved with more accurate guidance systems. Fifty Minuteman IIIs are being replaced with MX missiles.

The MX. The MX missile is considerably larger than Minuteman, more than tripling the throwweight and doubling the accuracy of its predecessor. One MX can deliver up to 10 Mk 21 warheads. Fifty MX missiles are currently being fielded in existing Minuteman III silos. The Administration has proposed fielding an additional 50 MX in a rail-basing mode beginning in 1991.

The SICBM. Current Administration plans call for deploying 500 new, small ICBMs (SICBMs) beginning in 1992. The SICBM will probably be about half the length of the MX missile and weigh only 20 percent as much. It would carry a single warhead, and have the accuracy needed to destroy hardened targets. These missiles would be deployed in mobile launchers collocated at Minuteman sites in peacetime.

THE BOMBER FORCE

About 30 percent of the bomber force is on continuous alert in peacetime--that is, ready to be launched on its mission within minutes of notification. During times of tension or crisis, most of the bomber force can be put on alert, and dispersed to more bases to increase chances for survivability. Bombers on alert are very likely to survive a preemptive attack, and can be recalled once launched, or can land and be recovered outside the United States. Bombers would take many hours to reach targets over the Soviet Union, however, and in the case of a penetrating bomber carrying short-range weapons, would face heavy Soviet air defenses. Cruise missiles launched from bombers have excellent ability to penetrate air defenses, but are relatively slow-flying.

FB-111A. A medium bomber first introduced in 1969, the FB-111A is expected to retain its strategic mission through the 1980s, and to phase into a tactical role in the early 1990s.

B-52G. Delivered between 1959 and 1961, the B-52Gs have received extensive structural and avionics modifications over the years. Ninety-eight B-52Gs were recently equipped to carry 12 cruise missiles (ALCMs) on external wing pylons. The remaining 69 B-52Gs will retain their nuclear roles until the late 1980s. By 1989, they will become a dedicated conventional/maritime support force. The ALCM-equipped B-52Gs will also carry nuclear bombs and short-range attack missiles until the B-1B becomes available in larger numbers to take over part of the penetrator role. Used thereafter as standoff ALCM carriers, these B-52Gs would probably be retired in the 1990s.

All B-52s have received avionics upgrades like the Offensive Avionics System (OAS) and new radio receivers, and most are receiving updated electronic countermeasures equipment.

B-52H. These bombers were delivered between 1961 and 1962. As of March 1987, about one-quarter of the 96 B-52Hs had been modified to carry ALCMs externally, as have the B-52Gs. These modifications should be complete by fiscal year 1990. A separate program will modify the aircraft to carry up to eight ALCMs internally as well. These aircraft will carry both cruise missiles and short-range weapons into the late 1980s, when they will begin taking on more of a stand-off cruise missile carrier role as new bombers are fielded and as the B-52Hs are modified to carry ALCMs internally.

B-1B. The B-1B will rely on a smaller radar cross section than the B-52s, improved speed and low-altitude capabilities, and sophisticated electronic countermeasures to penetrate Soviet air defenses through the 1990s. It will have cruise missiles added to its weapons mix when the Advanced Technology Bomber is fielded. The first B-1B was delivered in June 1985, and all 100 will be in the inventory by 1988.

Advanced Technology Bomber (ATB). The ATB, or "stealth" bomber, recently named the B-2, incorporates material and design technologies that would make detection by radar and infrared sensors quite difficult. The Administration chose the ATB program as the second part of its two-bomber modernization approach. It will be fielded starting in the early 1990s, with an ultimate force size of 132. Details are classified.

Air-Launched Cruise Missile (ALCM). The ALCM is a small, low-flying, nuclear-armed, unmanned aircraft to be carried by B-52 and B-1B bombers. Launched hundreds of miles from its target, it guides itself by comparing topographical features measured in flight with preprogrammed terrain information. The Administration plans to purchase a total of 3,200 ALCMs of all types, which will provide about 2,880 on-line missiles and a maintenance pipeline. This plan represents a decrease of about 900 deployable missiles from the Administration's 1981 program. The plan includes the substitution of an advanced cruise missile (ACM) currently being procured, that reportedly has longer range and, through "stealthy" technology, even lower radar

detectability than its predecessor. This new ACM would eventually account for somewhat less than half of the total ALCM inventory.

Short-Range Attack Missile (SRAM). Deployed in the early 1970s, these short-range nuclear-armed missiles can be launched from penetrating bombers to suppress in-route air defenses and to attack--from a distance--targets having their own air defenses. Beginning in 1993, a new SRAM--designated SRAM II--will begin replacing its aging predecessor. A new warhead plus increased range and accuracy will give these new missiles greater capabilities, especially against mobile and hardened targets.

THE SEA-BASED FORCES

Submarines at sea--more than two-thirds of the total force in peacetime--are currently the most survivable and enduring of U.S. forces. With the new Trident II (D-5) missile, this force will also have the capability to retaliate against hardened targets for the first time. Maintaining reliable, secure communications in time of war has always been the greatest area of concern and difficulty with respect to the submarine force.

Poseidon Submarines. Twenty-eight of the 31 original Poseidon submarines are still in the force. Twelve of these submarines carry the newer, more accurate, longer-range Trident I (C-4) missile. Currently, the Navy plans to operate its Poseidon submarines into the 1990s, for an average lifetime of about 30 years.

Trident Submarines. The newest addition to the ballistic missile submarine (SSBN) fleet is the Trident submarine. Considerably larger than the Poseidon, it has 24 launch tubes (instead of 16). The first Trident, USS OHIO, made its initial patrol in the fall of 1982. Seven Tridents are now operational, with an eighth in sea trials.

Fifteen of these submarines have been authorized through fiscal year 1988. The Administration projects a procurement rate of one submarine per year. The Navy plans to base the first eight Tridents in Bangor, Washington, and is building a second Trident base at King's Bay, Georgia. The Navy projects an ultimate force size of 20 Trident submarines, although no final determination has been made.

The first eight Trident submarines will be initially fitted with the Trident I (C-4) missile. Generally coincident with their first overhaul periods, they will be converted to carry the larger Trident II (D-5) missile. All Tridents after number eight will have the Trident II missile system installed during construction.

Poseidon (C-3) SLBM. The oldest deployed submarine-launched ballistic missile (SLBM), the 2,500-mile-range Poseidon (C-3) was introduced in 1971. It carries 10 relatively low-yield warheads and is deployed on 16 Poseidon submarines.

Trident I (C-4). Twelve Poseidons carry the longer-range (4,000 miles) Trident I (C-4) missile, introduced in 1979. Each of the first eight Trident SSBNs will carry the C-4 for about their first nine years of service until it is replaced by the Trident II (D-5). The Trident I carries eight warheads.

Trident II (D-5). The D-5 missile--to be deployed starting in 1989--will be significantly larger than its predecessor, the C-4, and will have a greater payload capability (up to 75 percent more than C-4), much better accuracy, and comparable range at maximum load. The Navy is reportedly planning to use a mix of smaller Mk 4 warheads and new Mk 5 warheads in the Trident II force. More of the smaller warheads can be put on each missile, giving better coverage of soft targets. The larger warhead, combined with the accuracy of the new missile--less than 500 feet Circular Error Probable--will give first-time "hard-target" destruction capability to the sea-based missile force. The missiles will reportedly carry no more than 12 Mk 4 or 8 Mk 5 warheads.

APPENDIX B

MEASURES AND METHODS USED IN THIS ANALYSIS

While the measure of deterrence is more than numerical, judgments about the state of deterrence cannot be made without a picture of the underlying numerical balance between the U.S. and Soviet strategic forces and trends in that balance. In assessing the capabilities of strategic forces, this study used measures of effectiveness that need to be precisely defined. It also made assumptions about force postures--or scenarios--that can greatly affect the analysis.

PRE-ATTACK MEASURES OF BALANCE

Some measures consider the numbers of weapons available before either side mounts an attack. These numbers are useful for measuring the relative parity and general stability of the U.S. and Soviet force balance. This analysis uses three main pre-attack measures of effectiveness.

Total Warheads. This is a measure of general capability against a potential set of targets. This measure includes warheads on all three types of systems of the U.S. nuclear triad: strategic bombers and land-based and submarine-based missiles.

Hard-Target Warheads. These represent a subset of total warheads. For purposes of this study, hard-target warheads include Class 1 and Class 2 warheads in a schema developed by CBO in a recent study.1/ These warheads have a high probability of destroying targets--such as

1. Class 1 warheads have a 70 percent probability of destroying a 5,000 psi target. Of the ballistic missile warheads, only the U.S. Mark 21 warheads on the MX ICBM and the planned small ICBM, and the Mark 5 warhead on the forthcoming Trident II SLBM would meet that standard. Class 2 warheads have a 70 percent probability of destroying a 2,000 psi target. The U.S.

(continued)

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ICBM silos, deep underground command and control centers, and leadership bunkers--that are highly hardened to withstand nearby nuclear detonations. Because these warheads can attack key military targets, they are analyzed separately.

Hard-target warheads on ballistic missiles--as opposed to those on bombers--are often distinguished as "prompt," since they would take only minutes to reach their targets and could be used in an immediate counterstrike on Soviet targets. Bomber-carried weapons would take hours to reach their targets. In a "bolt-out-of-the-blue" attack, some submarine-launched missiles might also be delayed because of activities, such as training and exercises, in which the submarine was engaged.

Another subset of hard-target warheads includes those that are deployed in fixed locations--namely, land-based intercontinental ballistic missiles (ICBMs) in silos. These systems are increasingly vulnerable to attack by more accurate weapons and, in the case of a multiple-warhead ICBM, they provide a favorable ratio of attacking warheads to warheads destroyed. Because this vulnerability could prompt their early use in a crisis, these systems often figure heavily in debates concerning stability of forces in a crisis.

Throwweight. This is a measure of the payload capacity of a missile. Many analysts consider this measure important because excess payload capacity can indicate ability to increase--perhaps surreptitiously--the size and/or number of warheads on a missile. Others consider the measure overemphasized. They cite the difficulty of making such

1. (continued)
Mark 12A warheads on Minuteman III missiles and Soviet warheads on the SS-18 meet that standard. In this study, the SS-25 is considered a Class 2 weapon, since its reported throwweight would allow it to carry a large warhead. However, this estimate is speculative. Class 3 warheads have a 70 percent probability of destroying a 500 psi target, which is representative of a group of medium-hard targets that include munition bunkers, leadership bunkers, command and control centers, and older Soviet ICBM silos. The U.S. Mark 12 warhead on some Minuteman III missiles and the Mark 4 warhead on forthcoming Trident II missiles meet that standard, as do Soviet warheads on the SS-17, SS-19, and, reportedly, the recently deployed SS-24. Of bomber-carried weapons, bombs, cruise missiles, and the forthcoming short-range attack missile (SRAM II) fall in the range of Class 1 and 2 war- heads. For additional details on hard-target warhead capability and this classification scheme, see *Trident II Missiles: Capability, Costs, and Alternatives*, pp. 8-12.

changes surreptitiously and consider the leverage of such increases minor, except perhaps when the overall levels of missile forces are very small. Excess throwweight also allows for a greater number of aids or decoys, which are useful for penetrating or overwhelming ballistic missile defenses.

POST-ATTACK MEASURES OF BALANCE

Because U.S. policy for deterrence calls for strategic nuclear forces capable of surviving an attack and retaliating, measures of post-attack or retaliatory capability are important. In addition, post-attack measures can illustrate the marginal contribution that continuing modernization programs make to U.S. capability. For instance, 500 small ICBM (SICBM) warheads that may be deployed in the 1990s would make only a small contribution to overall pre-attack measures of warheads or even hard-target warheads. Since these warheads will presumably be able to survive a Soviet attack, they make a larger contribution to U.S. retaliatory capability. Also, post-attack measures can indicate the options available to the United States after receiving a Soviet attack.

Post-attack and retaliatory measures used in this analysis are similar in category to pre-attack measures: total warheads, hard-target warheads, and throwweight. But they incorporate the results of an attack by the Soviet Union against U.S. strategic forces (including ICBMs, bomber bases, and submarine posts).

Post-attack measures must be described by the "scenario" accompanying a Soviet attack. An attack without advance warning (called a "bolt-out-of-the-blue" attack) is considered by many to be the greater challenge to U.S. capabilities. While silo-based ICBMs are always on alert, only about a third of the bomber force is on alert in peacetime--that is, poised to react promptly to escape a Soviet attack. On a day-to-day basis, more than two-thirds of the submarine force is at sea, and not vulnerable to attack. However, only a portion of those at sea are ready to respond quickly to a launch order. Given the large, proliferated arsenals of the superpowers, however, an attack without warning is also widely considered to be the most unlikely. If the structure or balance of strategic forces were such that an opponent felt a sur-

prise attack would be a decisive blow, then the danger and probability of this type of attack would be much greater.

An attack preceded by tensions or conflict elsewhere--such as Western Europe, the Middle East, or Southwest Asia--is considered most probable. In this scenario, escalation to nuclear war could arise out of a desire to intimidate or demonstrate resolve to a superpower opponent. While ultimately such escalation may result in an irrational level of damage--one far exceeding the original objective--it would not have begun that way.2/ Under these circumstances, more U.S. forces could survive even in the face of a larger attacking Soviet arsenal, since all systems except those in maintenance and overhaul could be brought to a war footing to escape destruction.

One other assumption is important in this analysis. In the general case, ICBMs in silos are assumed to "ride out" an attack since they cannot be dispersed. U.S. policy, however, neither assumes nor precludes launching these missiles upon confirmation that a Soviet attack was under way. In fact, the Soviet Union cannot be sure that the United States would ride out an attack on its ICBMs, especially in a case where a potential attack was anticipated.

METHODS USED FOR POST-ATTACK MEASURES

To assess the survivability of the silo-based ICBM force, this study used a simple allocation model that assigns the most capable of the available Soviet warheads to the most "valuable" U.S. missile silos, with value weighted by the number of warheads carried by the missile in that silo. Damage calculations are based on public estimates of Soviet missile characteristics, such as warhead yield and accuracy, and calculations of nuclear effects developed by the Defense Nuclear Agency.

The general case in the text--a Soviet attack with strategic warning--assumes that the Soviets would not conduct a barrage

2. While this scenario is describing escalation by the original aggressor, it is similar to the declared U.S. policy of "flexible response" in Europe where the U.S. would escalate to raise the price of aggression high enough to cause the Soviets to back down.

attack against dispersed mobile ICBM missiles because of the tremendous resources required. In the case of a surprise attack where the Soviets are assumed to attack these missiles, the damage algorithm, on which the expected destruction is based, uses what is known as a "cookie-cutter" or ratio-of-areas calculation. The calculation considers the relationship of the area (or line, in the case of Rail MX) of uncertainty within which the targets are dispersed, and the lethal area of the attacking missiles.

Submarines at sea are largely invulnerable today, and there are no indications that status will soon change. All submarines in port are assumed destroyed.

Because of their quick reaction time, the only significant threat to the initial survivability of bombers on alert in a Soviet attack are Soviet submarines patrolling off the U.S. coast. (Soviet air defenses are a threat to penetrating bombers on their retaliatory mission.) Barraging bombers in airspace poses an even greater demand on Soviet resources than barraging land-based mobile missiles. An earlier analysis by CBO indicates that, even with a barrage attack, the survivability of bombers on alert is extremely high. The greatest degradation occurs in the case of the Soviets using depressed trajectories for their SLBMs to shorten their time of flight--a capability they have not tested extensively if at all. Furthermore, Soviet practice has been to keep their newer submarines closer to their territory, probably lessening the threat of a barrage attack over time. In this study, it is assumed that the Soviets do not barrage airborne bombers. A description of the bomber survivability model and general results appear in the 1983 CBO study *Modernizing U.S. Strategic Offensive Forces: The Administration's Program and Alternatives.* Bombers not on alert are not expected to survive.

Limitations of the Measures

When using numbers of warheads to assess the capabilities of forces surviving an attack, several limitations should be kept in mind.

- The measures used in this study are most useful for observing trends in force survivability and retaliatory capability. The study does not examine detailed operational con-

siderations that would affect targeting and force survival in actual war plans. Also, projections of force structures and capabilities inevitably rely on many uncertain assumptions.

- As is the case with most other analyses of this type, this study assumes that the command and control system would be able to direct U.S. forces to retaliate in the desired manner after a Soviet first strike. If command and control were not able to survive and respond, most of the other analysis would be moot. The Administration has made a high priority of improving these capabilities.

- This analysis assumes that none of the U.S. strategic submarines at sea is destroyed in an attack. Most analysts would agree with this assumption for the 1980s, and Administration representatives have indicated that it is a reasonable assumption through the 1990s. While the Soviets have reportedly made great strides in rendering their own submarines less detectable, finding U.S. submarines should remain a difficult problem for them.

APPENDIX C

DETAILS OF THE STRATEGIC MODERNIZATION PROGRAM ASSUMED IN THE ANALYSIS

TABLE C-1. LAND-BASED MISSILE FORCE UNDER THE ADMINISTRATION'S MODERNIZATION PROGRAM (By fiscal year)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MM II	450	450	450	450	450	450	450	450	450	450	450	450	450	450
MM III (Mk12)	250	248	223	204	200	200	200	200	200	200	200	200	200	200
MM III (Mk12A)	300	300	300	300	300	300	300	300	300	300	300	300	300	300
MX Silo-based	27	46	50	50	50	50	50	50	50	50	50	50	50	50
SICBM	---	---	---	---	---	7	36	84	168	276	384	492	500	500
MX Rail-based	---	---	---	---	---	18	42	50	50	50	50	50	50	50

SOURCE: Congressional Budget Office projections based on Fiscal Year 1988 Report of Secretary of Defense Caspar W. Weinberger; Fiscal Year 1988 Congressional Data Sheets; DoD Selected Acquisition Reports.

NOTE: Modernization program not constrained by arms-control limits.

TABLE C-2. STRATEGIC BOMBER FORCE STRUCTURE UNDER THE ADMINISTRATION'S MODERNIZATION PROGRAM (By fiscal year)

	1987	1988	1989	1990	1991	1992	1993
B-52G							
Penetrate a/	61	61	0 b/	0	0	0	0
Standoff-Penetrate c/	89	89	0	0	0	0	0
Standoff d/	0	0	90	70	50	20	0
B-52H							
Penetrate	45	21	0	0	0	0	0
Standoff-Penetrate	45	69	79	58	39	20	0
Standoff	---	---	11	32	51	70	90
B-1B							
Penetrate	58	90	90	90	90	75	45
Standoff-Penetrate	---	---	---	---	---	15	45
ATB	---	---	---	---	2	14	46
ALCM/ACM e/	1,530	1,584	1,746	2,124	2,502	2,880	2,880
SRAM	1,100	1,100	1,100	1,100	1,100	1,100	1,035
SRAM II	---	---	---	---	---	---	90

SOURCE: Congressional Budget Office projections based on phasing of roles and missions described in Fiscal Year 1988 Report of Secretary of Defense Caspar W. Weinberger, February 1987 Fact Sheet provided by the Air Force, and budget information from the Department of Defense.

NOTES: All values are in terms of primary authorized aircraft (PAA), an Air Force measure that takes account of the roughly constant 10 percent of total aircraft in the maintenance pipeline and thus not available for use. Unless otherwise noted, bombers are assumed to use penetration tactics for weapon delivery.

The United States has 56 FB-IIIA bombers that are not counted as strategic bombers by the precedent of arms-control counting rules. These bombers are planned to be transferred to the Tactical Air Forces in the early 1990s.

TABLE C-2. (Continued)

	1994	1995	1996	1997	1998	1999	2000
B-52G							
Penetrate a/	0	0	0	0	0	0	0
Standoff-Penetrate c/	0	0	0	0	0	0	0
Standoff d/	0	0	0	0	0	0	0
B-52H							
Penetrate	0	0	0	0	0	0	0
Standoff-Penetrate	0	0	0	0	0	0	0
Standoff	90	90	90	90	90	90	90
B-1B							
Penetrate	15	0	0	0	0	0	0
Standoff-Penetrate	75	90	90	90	90	90	90
ATB	89	120	120	120	120	120	120
ALCM/ACM e/	2,880	2,880	2,880	2,880	2,880	2,880	2,880
SRAM	923	652	293	0	0	0	0
SRAM II	202	473	832	1,193	1,470	1,470	1,470

a. "Penetrate" refers to the tactic of flying over the target area to deliver the weapon.

b. The B-52G penetrators are shown retiring from their strategic nuclear force role. They are planned for a transition to purely conventional bombers.

c. "Standoff-penetrate" means that the aircraft carries a mixed load of standoff weapons (ALCMs) and short-range weapons, and would remain clear of most defenses while launching the ALCMs and before penetration.

d. "Standoff" aircraft carry ALCMs only and do not fly over the target area.

e. These PAA numbers were derived from ALCM inventory numbers provided in Department of the Air Force Congressional Data Sheets and estimates of ACM deliveries. ACMs will account for somewhat less than half the total inventory.

TABLE C-3. SEA-BASED STRATEGIC FORCE STRUCTURE UNDER THE ADMINISTRATION'S MODERNIZATION PROGRAM (By fiscal year)

	1987	1988	1989	1990	1991	1992	1993
Poseidon C-3							
On line	13	14	15	16	16	16	16
Overhaul	3	2	1	0	0	0	0
Poseidon C-4							
On line	10	12	12	12	12	12	11
Overhaul	2	0	0	0	0	0	0
Trident C-4 a/							
On line	8	8	8	8	7	6	5
Overhaul	0	0	0	0	1	2	2
Trident D-5 Backfit b/							
On line	---	---	---	---	---	---	1
Overhaul	---	---	---	---	---	---	0
Trident D-5							
On line	---	---	1	2	4	5	6
Overhaul	---	---	---	---	---	---	0
SLCM (Nuclear-armed) c/	183	287	423	622	758	758	758

SOURCE: Congressional Budget Office projections.

NOTES: The status of submarines is shown as of the last day of each fiscal year. Submarines not in overhaul or in post-overhaul shakedown periods are considered to be on line. Submarines are considered to be in overhaul if they are actually in overhaul or in post-overhaul shakedown periods.

a. Delivery dates for Tridents 1 through 15 are from Department of the Navy Congressional Data Sheets for the President's fiscal year 1988/1989 budget. Data for Tridents 16 through 20 are extrapolated from these data. Based on data supplied by Navy officials, CBO assumes the initial Trident overhauls will occur nine years after delivery; overhauls last 12 months plus an eight-month shakedown period after delivery and before the submarine goes on patrol. See also testimony of Rear Admiral James D. Murray, Jr., USN, before the Subcommittee on Defense, House Committee on Appropriations, *DoD Appropriations for 1980* (March 15, 1979), pt. 3, p. 418.

TABLE C-3. (Continued)

	1994	1995	1996	1997	1998	1999	2000
Poseidon C-3							
On line	14	11	8	5	3	0	0
Overhaul	0	0	0	0	0	0	0
Poseidon C-4							
On line	9	7	5	3	1	0	0
Overhaul	0	0	0	0	0	0	0
Trident C-4 a/							
On line	4	2	1	0	0	0	0
Overhaul	2	2	2	1	0	0	0
Trident D-5 Backfit b/							
On line	2	4	5	7	8	8	8
Overhaul	0	0	0	0	0	0	0
Trident D-5							
On line	7	8	9	10	11	12	12
Overhaul	0	0	0	0	0	0	0
SLCM (Nuclear-armed) c/	758	758	758	758	758	758	758

b. Trident D-5 backfit submarines are shown here to distinguish these conversions from the delivery of Tridents equipped with D-5 missiles. The backfit generally will be done with overhaul of the Trident C-4 submarines.

c. The total inventory objective for the nuclear-armed version of the Tomahawk land-attack missile (TLAM-N) has been widely reported, as has its initial deployment date. See, for example, the *Congressional Record*, May 31, 1984, H5051-5052; and *Armed Forces Journal International* (April 1987), p. 24. The *Congressional Record* also stated that the fiscal year 1985 procurement of TLAM-N was 75, or about 42 percent of the total Tomahawk procurement for that year. This schedule assumes that TLAM-N consistently accounts for 42 percent of the annual Tomahawk procurement because of its importance to the Administration's strategic program.

TABLE C-4. CHARACTERISTICS OF U.S. BALLISTIC MISSILE FORCES

System	Number of Reentry Vehicles	Yield per RV (Kilotons)	CEP (Nautical miles)	Throw-weight (In thousands of pounds)	System Avail-ability (Day-to-day)
Minuteman II	1	1,200	0.34	1.6	0.95 a/
Minuteman III					
Mk12	3	170	0.10	2.4	0.95
Mk12A	3	335	0.10	2.4	0.95
MX (Peacekeeper)	10	300	0.05	7.9 b/	.95
SICBM	1	475 c/	0.07	1.3 d/	0.90 e/
Poseidon (C-3)	10	40	0.25	3.3	0.66 f/
Trident I (C-4)	8	100	0.15	3.0 +	0.66
Trident II					
Mk4	12 g/	100	0.08	5.3 h/	0.66
Mk5	8	475	0.08	5.3	0.66
SLCM (TLAM/N)	1	170	0.05	---	n.a.

SOURCE: Congressional Budget Office from data in John M. Collins, *U.S.-Soviet Military Balance, 1977-1986* (Congressional Research Service, Report No. 87-745-S, 1987); T. Cochran, W. Arkin, M. Hoenig, *Nuclear Weapons Databook: Volume I--U.S. Nuclear Forces and Capabilities* (Cambridge, Mass.: Ballinger Publishing Co., 1984, for the National Resources Defense Council, Inc.); W. Arkin, T. Cochran, M. Hoenig, "Resource Paper on the U.S. Nuclear Arsenal," *Bulletin of the Atomic Scientists*, vol. 40, no.7 (August/September 1984), *The Military Balance 1986-1987* (International Institute for Strategic Studies, 1986).

NOTE: RV = reentry vehicle; CEP = Circular Error Probable; n.a. = not available.

a. Minuteman alert rates are said to be "well above 90 percent" and "virtually 100 percent" by DoD officials. See respectively, Office of the Joint Chiefs of Staff, Military Posture for 1983, p. 71, and testimony of Lt. Gen. Kelly Burke, USAF, before the House Committee on Armed Services, February 25, 1982.

b. From Department of Defense, "White Paper on the MX Missile System" (July 19, 1982), stating that the throwweight of MX is comparable to that of the Soviet SS-19, and about half that of the Soviet SS-18.

c. Arkin and others (1984) state that the W-87 warhead is designed so that its "baseline" yield of 300 kt can be upgraded to 475 kt by changing fissile materials. CBO assumes that the higher yield will be used for the SICBM.

d. Based on an article by Brigadier General Charles May in *Program Manager* (September-October 1986), stating that the 30,000 pound version had 1,000 pounds of throwweight. Current plan is for a 37,000 pound missile.

e. Since SICBM will be on a mobile transporter, CBO assumes its availability will be lower than that of the silo-based forces.

f. Based on recent estimates from Navy officials.

g. Michael Gordon, "U.S. Plans to Test Submarine Missile With 12 Warheads," *New York Times* (October 7, 1987), p. 1.

h. Estimate based on testimony of Rear Admiral William A. Williams, USN, before the Subcommittee on Strategic and Theater Nuclear Forces, Senate Committee on Armed Services, October 30, 1981, stating that the Trident II missile has about 75 percent more payload capability than the Trident I missile.

TABLE C-5. CHARACTERISTICS OF U.S. STRATEGIC BOMBER FORCES

System	Weapons Carriage (Maximum)			Weapon Yield (Kilotons)	CEP (Nautical miles)
	Bombs	SRAM	ALCM		
B-52G					
Penetrate	4	8	0	---	---
Standoff-Penetrate	4	8	12	---	---
Standoff	0	0	12	---	---
B-52H					
Penetrate	4	8	0	---	---
Standoff-Penetrate	4	8	12	---	---
Standoff	0	0	20	---	---
B-1B					
Penetrate a/	8	16	0	---	---
Standoff-Penetrate	8	16	14	---	---
Standoff	0	0	22	---	---
ATB b/	5	10	0	---	---
Gravity Bomb	---	---	---	1,000	0.07-0.10
ALCM/ACM	---	---	---	200	0.05 c/
SRAM	---	---	---	200	0.20
SRAM II	---	---	---	200	0.05 d/

SOURCE: Congressional Budget Office estimates. Unless otherwise indicated, weapons carriage parameters are based on Undersecretary of Defense Richard A. DeLauer, letter of November 17, 1981, to Senator Ted Stevens, *Congressional Record*, December 1, 1981, S14171-14172. Other parameters are from testimony of Paul Nitze before the Senate Committee on Foreign Relations, July 12, 1979. See also John M. Collins, *U.S.-Soviet Military Balance, 1977-1986* (Congressional Research Service, Report No. 87-745-S, 1986), pp. 24-25.

NOTE: The table indicates maximum weapons carriage for a mix of weapons. Operational weapons carriage is often less than maximum capability for a variety of reasons. One reason may be constraints imposed by the available inventory of weapons, especially in the case of the SRAM. Other reasons may relate to the characteristics of the planned mission. For example, the B-1B can hold either weapons or fuel in some internal weapons bays, depending on mission requirements.

a. Estimates assume no weapons carried externally in a penetrator mission. Up to 14 additional bombs/SRAMs could be carried externally.

b. The Advanced Technology Bomber (B-2) is reportedly capable of carrying less than half the payload of the B-1B. See Congressman Bill Chappell, Jr., statement in *Congressional Record*, November 18, 1981, H8488.

c. This is a composite estimate based on Nitze, op. cit.; information in Richard K. Betts, ed., *Cruise Missiles: Technology, Strategy, Politics* (Washington, D.C.: Brookings Institution, 1981); and Congressman Les Aspin, "Judge Not by Numbers Alone," *Bulletin of the Atomic Scientists* (June 1980), pp. 28-33.

d. The ring-laser gyro guidance system for the SRAM II will reportedly make it more accurate than the SRAM. See *International Defense Review* (August 1987), p. 1018.

APPENDIX D

SOVIET STRATEGIC FORCES

TABLE D-1. ILLUSTRATIVE SOVIET BALLISTIC MISSILE FORCES AND CHARACTERISTICS

System	Number Deployed 1987	1990	1996	Number of Reentry Vehicles	Yield per RV (Kilotons)
SS-11	440	250	0	1	950
SS-13	60	0	0	1	600
SS-17	150	0	0	4	750
SS-18	308	258	0	10	500
Follow-on	0	50	308	14	500
SS-19	360	360	150	6	550
SS-X-24/silo	0	150	360	10	(100)
SS-X-24/mobile	0	50	100	10	(100)
SS-X-25 c/	100+	252	252	1	(550-1,200)
SS-X-25MOD2	0	0	189	3	(335-550)
SS-N-6 (YI)	272	208	128	1	1,000
SS-N-8 (DI, DII)	292	292	256	1	800
SS-N-18 (DIII)	224	160	0	3	500
SS-N-20 (Typhoon)	80	120	200	6-9	(100)
SS-N-23 (Delta III, IV, V)	64	144	368	10	(250)

SOURCE: Congressional Budget Office estimates. Force structure estimates are based primarily on Department of Defense, *Soviet Military Power 1987*, and testimony of Robert M. Gates and Lawrence K. Gershwin (representatives of the Central Intelligence Agency) before a joint session of the Subcommittee on Strategic and Theater Nuclear Forces, Senate Committee on Armed Services, and the Defense Subcommittee, Senate Committee on Appropriations, "Soviet Strategic Force Developments," June 26, 1985. System characteristics based on John M. Collins, *U.S.-Soviet Military Balance*, 1977-1986 (Congressional Research Service, Report No. 87-745-S, 1987); Barton Wright, *World Weapon Database*, vol. I, Soviet Missiles (Brookline, Mass.: Institute for Defense and Disarmament Studies, 1986); *The Military Balance 1986-1987* (International Institute for Strategic Studies, 1986); Michael R. Gordon, "CIA Downgrades Estimate of Soviet SS-19," *National Journal*, 29 (July 20, 1985), p. 1692; "Soviets' Nuclear Arsenal Continues to Proliferate," *Aviation Week and Space Technology* (June 16, 1980).

NOTE: System characteristic estimates for the new Soviet missiles are highly speculative, as indicated by parentheses. Trends in estimates for accuracies of Soviet ICBMs attempt to account for expected Soviet efforts to incrementally improve accuracy through modifications of missiles. n.a. = not available.

TABLE D-1. (Continued)

System	Circular Error Probable (Nautical miles) a/ 1987	1990	1996	Throw-weight (In thousands of pounds)	System Avail-ability b/
SS-11	0.76	0.76	0.76	2.2	0.85
SS-13	0.82	0.82	0.82	1.3	0.85
SS-17	0.20	0.20	0.20	6.0	0.95
SS-18	0.13	0.13	0.13	16.7	0.95
Follow-on	---	0.10	0.10	16.7	0.95
SS-19	0.20	0.20	0.20	7.5	0.95
SS-X-24/silo	---	0.20	0.15	8.0	0.95
SS-X-24/mobile	---	0.22	0.17	8.0	0.85
SS-X-25	0.20	0.20	0.20	3.0	0.85
SS-X-25MOD2	---	---	0.15	3.0	0.85
SS-N-6 (YI)	---	0.7	--	1.6	n.a.
SS-N-8 (DI, DII)	---	0.8	---	1.8	n.a.
SS-N-18 (DIII)	---	0.5	---	2.5	n.a.
SS-N-20 (Typhoon)	---	(0.5)	---	(3-5)	n.a.
SS-N-23 (Delta III, IV, V)	---	(0.4)	---	(3-5)	n.a.

a. Single estimates are for all three years and reflect lack of data regarding trends in SLBM accuracy; official sources do not predict that the Soviets will acquire hard-target capable SLBMs in the time frame of this study.

b. Older liquid-fueled ICBM systems assumed analogous to Titan II; newer systems assumed similar to U.S. ICBMs. It is difficult to provide availability figures for Soviet SLBMs. Availability of older, shorter-range systems is much less than that for the United States. However, the newer long-range systems that the Soviets could launch from or near their home ports presumably have fairly high availability rates.

c. *Soviet Military Power, 1987*, p. 120, states that the SS-25 is five times more accurate than the SS-13--the USSR's first solid-propellant ICBM--and it has twice the throwweight. This would give it substantially greater throwweight than the single-warhead Minuteman II, which has a 1,200 kt warhead.

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